

**TESTS ON THE EFFICIENCY OF THE
SOUTH AFRICAN FOREIGN EXCHANGE MARKET**

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by

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ABSTRACT

This thesis consists of an analytical and empirical investigation into the efficiency of the South African foreign exchange market.

Part 1 of the thesis consists of a review of developments in the South African foreign exchange market. At the time of the Commission of Inquiry's Interim Report in 1979, a wide ranging system of exchange controls was in place. The authorities applied a dual exchange rate system and followed a U.S. dollar-peg system for the Commercial rand.

This thesis analyses in detail the significant reforms which were implemented in the post-Commission of Inquiry period, including the adoption of a flexible exchange rate system, the abolition of the dual exchange rate system and the adoption of a forward policy which was based on interest differentials. Steps were undertaken to integrate the spot and forward markets. In September 1985 the authorities declared a foreign debt standstill, reintroduced the Financial rand system and expanded the direct controls over foreign exchange transactions. There remains a wide ranging system of exchange controls in place at the present time which restricts the freedom of traders to transact in foreign exchange.

Part 2 consists of empirical tests on the efficiency of the South African foreign exchange market over this period of market reform and reversal. An efficient market is one in which prices fully reflect all available information. This definition requires the specification of testable hypotheses.

The writer's review of published studies on market efficiency undertaken in overseas markets reflect mixed results. Generally, deviations from covered interest parity were reported when comparing securities issued in different political jurisdictions, and this may reflect differences due to varying political risks, capital controls or tax legislation. Tests for covered interest parity in Euro-currency markets indicated that deviations were not sufficient to offset related transaction costs. The results of studies which analysed the relationship between spot and forward rates were generally consistent with market efficiency. Published studies using serial correlation tests generally indicated zero correlation in exchange rate changes. However, some studies reported significant profits from using filter trading rules.

This thesis employed various methodologies to test for market efficiency. Firstly, market efficiency was examined by testing the validity of the covered interest parity theorem. In an efficient market risk-free covered interest

profit opportunities should be quickly eliminated. The results of the tests were consistent with market efficiency. Further, market efficiency was tested by examining the relationship between the spot rate and the forward rate. In an efficient market, assuming a zero risk premium, the forward rate should be a weak but unbiased predictor of the future spot rate. The results of the tests were consistent with market efficiency.

The results of mean and autocorrelation tests validated the assumption of a zero risk premium in the pricing of forward exchange. This thesis found a strong correlation between movements in the spot rate and movements in the contemporaneous forward rate. The addition of lagged forward rates to the regression equation, which examined the relationship between the spot rate and the corresponding forward rate, reflected coefficients which were not significant. The forward premium was found to be a weak predictor of the future change in the spot rate. These results are consistent with market efficiency, for if the current spot rate and forward rate embody all current information then new information which alters expectations should be immediately reflected in the spot and forward rates.

Further tests of market efficiency were based on specified information sets; weak form efficiency requires that the

current spot rate reflects all information implicit in the past history of exchange rates, and semi-strong efficiency requires that the current spot rate reflects all publicly available information.

Tests for weak form efficiency followed various methodologies. Using regression analysis, the spot rate was found to follow a random walk, which is consistent with market efficiency if equilibrium returns are assumed to be constant. Tests for serial correlation included examining the autocorrelation function for various currencies over varying time periods. Generally, the tests reflected autocorrelation coefficients which were not significantly different from zero, thereby indicating that no linear trends existed in spot exchange rate changes. Tests for dependencies were expanded by testing the profitability of filter trading rules relative to a simple buy-and-hold policy. Filter trading rules were not able to outperform a simple buy-and-hold policy once an adjustment was made for interest returns earned on securities quoted in each currency, and once an adjustment was made for a minimum level of transaction costs.

In an efficient market, the forecasting accuracy of a foreign exchange advisory service should not systematically outperform the forward rate as a predictor of the future spot rate. Tests on the performance of a major South

African foreign exchange advisory service indicated that traders who used the advisory service's forecasts would have reported significantly smaller mean squared forecasting errors, and additional tests indicated that the advisory service outperformed the forward rate in predicting the directional change in the spot exchange rate. These results are not consistent with market efficiency.

Further tests were employed to examine the relationship between changes in the spot rate and changes in macro-economic variables. Tests indicated a statistically significant correlation between movements in the spot rate and movements in the contemporaneous Financial rand rate, the gold price and the Reserve Bank's foreign exchange reserves. As these are contemporaneous relationships, traders would usually not be able to use such relationships to improve their forecasts of the future spot rate. Regressions were applied to lagged changes in these variables and the coefficients were not significantly different from zero, and the values of R^2 were very close to zero. This is consistent with market efficiency as traders were not able to use past information of these variables to improve their forecasts of the future spot rate.

Information on current and lagged money supply growth, relative money supplies and the balance on the current account were found to be not significant in explaining

exchange rate changes. This is consistent with market efficiency as traders were not able to use publicly available information on these variables to improve their forecasts of the future spot rate.

In general, the tests in this thesis were consistent with the weak form and semi-strong forms of market efficiency. This thesis attempts to reconcile these results to the existence of a wide ranging system of exchange controls. Tests indicated that an advisory service's forecasts outperformed the forward rate in predicting the future spot rate. Although this is not consistent with market efficiency, this may reflect monopolistic access to information. Therefore this test may reflect a test of the strong form level of efficiency and the results may indicate an absence of market efficiency in the strong form sense.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The adoption of a flexible exchange rate system in South Africa, has led to increased interest in the determinants of exchange rate movements and the efficiency of the foreign exchange market. The Commission of Inquiry into the Monetary System and Monetary Policy in South Africa (hereafter referred to the "Commission of Inquiry"), indicated a move in official Reserve Bank policy toward market determined exchange rates. Various measures were introduced to expand the foreign exchange market to allow supply and demand factors to determine exchange rate movements. The reform process was halted with the declaration of the debt "standstill" in September 1985, and various direct controls were reinstated.

The existence of direct controls with a flexible exchange rate system creates interesting scenarios and raises

several important questions. Is the foreign exchange market efficient? Do prices reflect the public information set? Have there been opportunities to engage in profitable risk-free arbitrage activities? How well do forward exchange rates predict future spot rates? Is the forward rate an unbiased predictor of the future spot exchange rate? Are changes in the exchange rate serially uncorrelated? Is it possible to devise a trading rule which consistently outperforms a simple buy-and-hold policy? Are professional forecasting services able to outperform the forward rate in predicting the future spot exchange rate? Are there any significant relationships between the exchange rate and macro-economic variables which can be utilised to earn abnormal returns? This study attempts to answer these questions.

The dissertation is divided into 2 parts. Part 1 examines the technical side and recent developments in the South African foreign exchange market. Efficiency is evaluated in terms of the degree of economic freedom available to traders in the foreign exchange market. Direct controls and Reserve Bank intervention restrict economic freedom in that supply and demand for foreign currency are affected,

perhaps resulting in a different rate of exchange as compared to that if the market was free of such direct controls and intervention. This may result in an inefficient allocation of resources.

Part 2 of the study tests the Efficient Market Hypothesis in the context of the foreign exchange market. The development of the Efficient Market Hypothesis (EMH) has had important implications for understanding security pricing. The EMH implies that investors react immediately to take advantage of new information that has an impact on security prices. In overseas markets, tests of market efficiency have been documented by amongst others Levich (1979[a] and [b]), Frenkel (1981), Mussa (1979), Frenkel and Levich (1979), Cornell (1977), and Crystal and Thornton (1988).

1.2 DEFINITIONS, CONDITIONS AND LEVELS OF MARKET

EFFICIENCY

An efficient market is a market in which prices "fully reflect" all available information (Fama, 1970). Therefore, traders and market participants should not be able to earn abnormal returns. The following market

conditions reflect sufficient conditions for an efficient market;

1. Trading is costless. There are no transaction costs.
2. Information is costlessly available to all traders and market participants
3. All traders and market participants have homogeneous expectations with respect to prices.

These conditions, although sufficient for market efficiency, are not indicative of active markets in practice. Fama (1970) states that although these conditions are sufficient for market efficiency, they are not necessary conditions.

These conditions can be relaxed and yet still reflect an efficient market in that prices fully reflect available information. A market may be efficient if transaction costs are reasonable, information is available to a sufficient number of traders and there is no evidence that there are traders "who can consistently make better evaluations of available information than are implicit in market prices" (Fama, 1970).

To provide a framework for empirical research studies, Fama (1970) has defined market efficiency in relation to the specific information sets available to traders and market participants. There are three levels of market efficiency;

1. Weak form - traders are not able to earn abnormal returns by using only the past history of exchange rates. Therefore, the current spot rate fully reflects the information implied in past movements in the exchange rate.
2. Semi-strong form - traders are not able to earn abnormal returns by using all publicly available information, (such as information on money supplies, gold price, foreign exchange reserves), and included in the public information set is the past history of exchange rates. Therefore the current exchange rate reflects all publicly available information.

3. Strong form - traders are not able to earn abnormal returns by using all information. Therefore, the current exchange rate reflects all public and private information so that traders with privileged or monopolistic access to any information are not able to use such information to earn abnormal returns.

This study will examine the efficiency of the South African foreign exchange market by testing for weak form and semi-strong form efficiency. Therefore, in the context of this study, the foreign exchange market is efficient if the exchange rate fully reflects all publicly available information.

An efficient market implies that the exchange rate adjusts immediately to reflect new information. Currently available information which impacts on expectations cannot be used to systematically predict future exchange rates as such information has already been impounded in the current

spot exchange rate. In contrast, an inefficient market implies that exchange rates respond slowly to new information, so that traders can utilise new information to improve their forecasts of the future spot exchange rate.

As there is no overall test of market efficiency, tests of efficiency should be measured against specific alternative hypotheses.

1.3 OBJECTIVES AND FORMULATION OF HYPOTHESES

The study consists of two major objectives. The first objective is to test and evaluate the degree of economic efficiency in relation to the extent that technical and statutory factors impact on the freedom of economic choice facing investors and traders transacting in foreign currencies.

The second objective of the study is to test the EMH in the context of the South African foreign exchange market. This general objective is divided into specific hypotheses:

1. Covered interest arbitrage profit opportunities are quickly eliminated, and,

2. The spot rate, and/or forward rate should reflect the foreign exchange market's best estimate of the future spot rate.

The first hypothesis involves testing the covered interest parity theorem on a set of South African data, i.e. the forward premium/discount should reflect interest differentials between observed currencies. A regression model is developed to test the validity of the covered interest parity theorem between the rand and the U.S. dollar for the period 1981-1988. However, the absence of covered interest parity does not by itself constitute that the market is inefficient. Covered interest arbitrage profit opportunities may reflect an efficient market if these profit opportunities are not in excess of relevant transaction costs. Therefore, transaction costs result in arbitrage boundaries and market efficiency requires that observations lie within this interest parity band.

The second hypothesis is based on the EMH, that is, the current exchange rate is determined by expectations and reflects all available information. Changes in the exchange rate will be due to new information which has an

impact on future expectations. We would expect the following conditions to exist in an efficient market:

- There should be a strong correlation between movements in the spot rate and movements in the contemporaneous forward rate.
- The forward rate should not be a good predictor (although it should be an unbiased predictor) of the future spot rate.
- Technical trading rules should not consistently outperform a simple buy-and-hold policy.
- Professional forecasting services should not consistently outperform the forward rate in predicting the future spot exchange rate.
- Investors should not be able to earn abnormal profits from forecasts of the exchange rate based on publicly available information.

Statistical tests of the relationship between key variables will be performed to measure compliance with the above conditions.

1.4 OVERVIEW

Chapter 2 reviews and analyses South African foreign exchange policies since the breakdown of the Bretton Woods agreement in 1971 to the Interim report of the Commission of Inquiry in 1979. The chapter restates the main conclusions of the Commission of Inquiry Interim report, analyses the direct controls applicable in the South African foreign exchange market and evaluates the effects that such controls have had on the freedom of traders and investors in the foreign exchange market.

Chapter 3 analyses developments since 1979, that is, since the publication of the recommendations contained in the Interim report of the Commission of Inquiry. Developments in the spot market and forward market are reviewed to test that conditions in the foreign exchange market were conducive to allow the operation of market forces to determine the spot and forward exchange rates.

Chapter 4 consists of a literature review of various studies which test covered interest parity and the existence of covered interest profit opportunities. In addition, the chapter reviews studies which test the efficiency of the foreign exchange market by analysing changes in spot rates, forward rates and other macro-economic variables.

Chapter 5 describes covered interest parity and covered interest arbitrage. A regression model is used to test for interest parity on a set of weekly observations from August 1983 to February 1988. The same regression model is applied to a set of monthly observations from January 1983 to October 1986. Transaction costs are included in the analysis to test for the existence of covered interest arbitrage profit opportunities in excess of related transaction costs.

The purpose of Chapter 6 is to test the second hypothesis by examining the time series behaviour of the spot rate and the forward rate. If spot and forward rates embody all current information, and it is new information that alters expectations regarding the future spot rate, then there

should be a strong correlation between movements in the spot rate and movements in the contemporaneous forward rate. The ability of the forward rate to predict the future spot rate is tested, and analysed graphically. Assuming a zero risk premium, the forward rate should be an unbiased predictor of the future spot rate. Unbiasedness tests are applied to the forward rate. Further tests are applied to test for the existence of a risk premium in the pricing of forward exchange.

Exchange rate movements are analysed to evaluate the validity of the economic theories of the foreign exchange market. The behaviour of spot and forward exchange rates gives credence to the view that exchange rates are determined by expectations and reflect at any point in time the public information set. Movements in exchange rates reflect the arrival of new information which alters expectations. Changes in spot rates and forward rates are closely related as new information will impact on both exchange rates immediately. No significant evidence was found to support the existence of a risk premium in the pricing of forward exchange.

Chapter 8 states the conclusions of the various tests of market efficiency. The results are evaluated in terms of the objectives and hypotheses set out in Chapter 1 and the chapter concludes with suggestions for further research.

1.5 LIMITATIONS

Chapters 2 and 3 document developments and restrictions on traders in the South African foreign exchange market. An implicit assumption is that a competitive market and a market free of exchange control restrictions and other regulations would result in an efficient allocation of resources in the economy. However, an alternative argument states that an absence of exchange controls may result in "excessive" volatility in exchange rates and thereby hinder trade. An implicit assumption in this thesis is that a market free of exchange controls will result in an efficient allocation of resources.

There is no overall test of market efficiency. The definition of an efficient market is of a general nature and requires the specification of specific and empirically testable hypotheses. This implies that the results of

tests on specific hypotheses are necessary but not sufficient indicators of overall market efficiency.

Market efficiency is relevant in relation to a specified information set. Formally, market efficiency usually requires that;

$$E (S_t - S_{e,t} | I_{t-1}) = 0$$

Where $S_{e,t}$ is the one-period ahead forecast of the spot exchange rate based on the information set available at time $t-1$, I_{t-1} . E is the expectations operator. This means that traders do not systematically make errors in setting forecasts of the future spot rate.

Tests for market efficiency require that the error term should consist of white noise and be serially uncorrelated. This, however, is a test of a joint hypothesis, firstly that traders are rational in forming their expectations to the extent that they do not make systematic forecasting errors, and that the expected market equilibrium return is constant.

Therefore, in an efficient market prices should follow a random walk with drift. However if the equilibrium return is not constant and is serially correlated, then although there is resulting serial correlation in the error term, this does not necessarily mean the market is inefficient (see Levich, (1979[b])). A number of studies have tended not to recognise this point (see, for example, Crystal and Thornton, 1988). In this study, although we use the usual methods to test for market efficiency, a necessary limitation is that the tests of efficiency implicitly assume a constant equilibrium return.

In relation to the forward market, assuming traders are risk neutral, an efficient market requires that the forward exchange rate reflects the expected future spot rate;

$$S_{e,t} = F_{t-1}$$

In an efficient foreign exchange market;

$$S_t = S_{e,t} + u_t$$

where $S_{e,t}$ is equal to $E(S_t | I_{t-1})$ and u_t is a white noise error term. E is the expectations operator and I_{t-1} is the

information set at time $t-1$. Therefore, following on from these equations, in an efficient market;

$$S_t = F_{t-1} + u_t$$

However, this is a test of a joint hypotheses; that traders are rational in forming their expectations, and there is a zero risk premium in the pricing of forward exchange. The market may be efficient in the sense that traders are rational, but require a risk premium to hold forward exchange. In this study, tests of efficiency are undertaken assuming a zero risk premium. The validity of assuming a zero risk premium is then tested as a separate exercise.

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PART 1

CHAPTER 2

REVIEW AND ANALYSIS OF SOUTH AFRICAN FOREIGN EXCHANGE POLICIES TO 1979.

OBJECTIVE:

The objective of this chapter is to present a background to developments in the South African foreign exchange market, to present the effects of Reserve Bank policies up to the time of the Interim report of the Commission of Inquiry in 1979, and to make intuitive and tentative conclusions on the effects of policy changes on market efficiency in so far as these policies restricted the freedom of traders/investors to transact in foreign exchange.

2.1 REVIEW OF FOREIGN EXCHANGE POLICIES TO 1979

2.1.1 THE SPOT MARKET

The system of fixed exchange rates as instituted under the Bretton Woods Agreement finally broke down in August 1971 with the Nixon declaration that the U.S. dollar would no longer be convertible into gold, at U.S. \$35 per ounce. This occurred due to persistent deficits incurred by the USA which resulted in the accumulation of U.S. dollars by the major central banks. This led to speculation against the U.S. dollar on the premise that the USA would no longer be able to convert U.S. dollars into gold at the stated price.

The realignment of currencies in terms of the Smithsonian Agreement in 1971 resulted in an effective devaluation of the U.S. dollar in terms of gold. The breakdown of the Smithsonian Agreement resulted in the generalised floating of the world's major currencies. Most countries within the European Economic Community joined the European Monetary System (EMS) whereby the values of currencies within the EMS were maintained within narrow bands. The EMS currencies floated together against the U.S. dollar.

Most less developed countries pegged their currencies to a major currency such as the U.S. dollar, UK sterling and the French franc. The rand was initially pegged to sterling but then became pegged to the U.S. dollar. In terms of the Smithsonian Agreement, the rand was devalued by 12.28 percent. It is interesting to note the stated reasons for this devaluation as these same reasons were repeated on numerous occasions when the authorities undertook to alter the pegged value of the rand.

The devaluation was firstly intended to improve South Africa's balance of payments, as devaluation was expected to reduce the current account deficit. It would assist to reverse the leads and lags effects on the Reserve Bank's foreign currency reserves. It was envisaged that the devaluation would encourage capital inflows and increase rand revenues due to exporters of primary commodities and gold. The devaluation was also expected to improve the competitiveness of local industry and increase government revenue (Commission of Inquiry Interim Report, 1979 : p.5).

The Commission of Inquiry report noted that "during the period following the devaluation, both the overall balance

of payments and the domestic economic situation improved considerably..." (Commission of Inquiry Interim Report, 1979 : para. 32). The Commission of Inquiry failed to report that the devaluation was combined with the implementation of tariffs to reduce imports and, the adoption by the authorities of export promotion policies.

The argument that devaluation would encourage capital inflows is a short-term view; devaluation would encourage capital inflows if funds were committed and investors were concerned about timing. In relation to long-term capital inflows, the process of devaluation may discourage investors from investing funds in South Africa. This is due to the impact that devaluation may have on expectations regarding future movements in the value of the rand.

After a short period of being pegged to sterling, the rand was again linked to the U.S. dollar in October 1972. In February 1973, the U.S. dollar was devalued by 10 percent. The authorities decided not to follow this devaluation due to South Africa's favourable balance of payments position and the healthy state of its foreign exchange reserves. South Africa's balance of payments and, directly related to

this, the level of foreign currency reserves, had an important effect on official exchange rate policy.

The volatility of the U.S. dollar in terms of the major currencies created problems for the rand. The rand/U.S. dollar link resulted in significant movements in the value of the rand in terms of other currencies. These movements were often not related to South Africa's own balance of payments position. South Africa experienced an appreciation in the value of the rand in a period (June 1973-January 1974) when its foreign reserves in fact declined. During another period in 1974, South Africa experienced a depreciation in the value of the rand while its foreign reserves were rising (Commission of Inquiry Interim Report, 1979: para.36).

In order to overcome the above "anomalies", the authorities implemented a system of managed pegging, termed the "independent managed floating" of the rand, by the Commission of Inquiry. This policy retained the link to the U.S. dollar but the value of the rand in terms of the U.S. dollar would be subject to smaller and more frequent adjustments.

In view of the fact that the authorities outlined the disadvantages of the rand/U.S. dollar peg in terms of movements of the value of the rand against the world's major currencies, it is not surprising to note that the authorities applied a policy of maintaining a rand/U.S. dollar link but effectively followed a policy of pegging the rand to a weighted basket of currencies. Therefore, the value of the rand/U.S. dollar rate would be adjusted on the basis of movements in the value of the rand in terms of a weighted basket of currencies. This policy facilitated the ability of traders and speculators to predict the future value of the rand/U.S. dollar rate and this resulted in significant leads and lags effects on the foreign exchange reserves.

The appreciation of the U.S. dollar in 1975 resulted in expectations of a downward adjustment to the rand/U.S. dollar rate. This resulted in importers leading payments for imports, thereby increasing the immediate demand for foreign currency. At the same time, exporters lagged their foreign currency receipts. The combined effects of these actions was to cause a significant decline in the country's foreign currency reserves.

The authorities decided to again implement a fixed U.S. dollar peg from June 1975, whereby the value of the rand would remain constant for longer periods in terms of the U.S. dollar.

The further strengthening of the U.S. dollar and South Africa's weak balance of payments position led to pressures for a downward revision in the rand/U.S. dollar peg. South Africa had also experienced a material decline in the price of gold. These factors led to a devaluation of the rand by 17.9 percent in September 1975. This devaluation resulted in an improvement in the Reserve Bank's foreign exchange reserves due to a reversal of unfavourable leads and lags.

However, South Africa's foreign exchange reserves were again subjected to pressure in 1976 due to political disturbances. During 1977 and 1978, in part due to the domestic recession, the current account reflected a substantial surplus while the capital account reflected net capital outflows. The rand remained linked to the U.S. dollar which generally depreciated against the major currencies over this period.

Therefore, until the advent of the Commission of Inquiry's Interim Report in 1979, the authorities had experimented with various exchange rate policies in relation to the spot rate. The state of the country's balance of payments and foreign currency reserves were the major factors in determining official exchange rate policy to 1979.

2.1.2 THE FORWARD MARKET

Up to 1979, the Reserve Bank provided forward cover to the banks in relation to commitments involving the movement of goods. The Reserve Bank would sell forward U.S. dollars to cover imports and purchase forward U.S. dollars to cover exports. In relation to imports, cover was granted up to a year, whereas in relation to exports, cover was normally restricted to six months. The Reserve Bank also granted forward cover to parastatal organisations on their overseas borrowings including interest commitments on foreign loans.

The Reserve Bank set the cost of forward cover at one percent per annum on both forward sales and forward purchases, i.e. forward rates were based on the spot rate plus a charge of one percent. Therefore, forward cover

would be granted to importers at the spot rate (indirectly quoted) less one percent per annum. Forward cover would be granted to exporters at the spot rate plus one percent per annum. The Reserve Bank's forward exchange policy resulted in a material difference between forward buying and selling rates.

2.1.3 EXCHANGE CONTROL

The authorities implemented a wide range of exchange controls over residents and non-residents in order to reduce the demand for foreign currency. A major component of exchange control for limiting capital outflows is dependent upon applying a dual exchange rate system (which is explained below). An important exchange control ruling is Regulation 3(1)(f) which sets limits on local borrowings by foreign controlled companies.

2.1.4 THE SECURITIES RAND

The Sharpeville disturbances in 1960 led to large capital outflows. To protect the country's foreign exchange

reserves, the authorities introduced measures to block the repatriation of assets held by non-residents. Capital repatriation by non-residents could be effected by purchasing scrip (shares) on the Johannesburg Stock Exchange and selling the same scrip on the London Stock Exchange, normally at a discount to the quoted official exchange rate. Blocked rands could also be used to purchase non-resident bonds, and government, municipal and parastatal corporation stocks. (see C.R. Freemantle, 1977: p.9). Although officially not recognised, a secondary market arose whereby non-residents traded blocked rands at a discount to the quoted rate (Gidlow, 1976 : p.87). Official recognition was granted to this secondary market for blocked rands and these rands became known as securities rands in 1976. (Gidlow, 1979: p.255).

2.2. ANALYSIS OF THE INTERIM REPORT OF THE COMMISSION OF
INQUIRY INTO THE MONETARY SYSTEM AND MONETARY POLICY
IN SOUTH AFRICA

2.2.1 INTRODUCTION

The Commission of Inquiry was appointed in August 1977 under the chairmanship of Dr. G.P.C. de Kock to inquire and make recommendations in respect to the monetary system and monetary policy in South Africa with special reference to various factors, one factor being "exchange rate and forward exchange policies and practices, and the development of a foreign exchange market in South Africa". (Commission of Inquiry Interim Report, 1979 : p.(iii)). Due to the turmoil experienced in the world's foreign currency markets and a depreciating U.S. dollar, the Commission was requested to present an Interim Report on foreign exchange management.

The Interim Report was published in early 1979. Exchange rate policy was seen in the broad context of monetary policy. As the Commission states in its report,

"in short-term economic stabilisation policy in South Africa the main emphasis should be placed upon conservative monetary and fiscal policies and on general financial discipline. Exchange rate policy can never be a substitute for such policies and discipline. Exchange rate adjustments cannot by themselves solve the problems of either slow economic growth, balance of payments disequilibrium or inflation"

(Commission of Inquiry, 1979 : para. 8)

However, the importance of exchange rate policy was recognised in lieu of the fact that South Africa is an open economy where the total value of foreign exchange transactions is significant in relation to the country's gross domestic product.

The Commission concluded that there were serious deficiencies with various aspects of the South African foreign exchange market.

2.2.2 THE SPOT MARKET

The spot market reflected certain weaknesses. The Commission concluded that the most important deficiency was the policy of maintaining a relatively fixed rand/U.S. dollar peg. Changes to the rand/U.S. dollar peg were implemented infrequently and also tended to be material (for example, the 17.9 percent devaluation in 1975). The maintenance of the rand/U.S. dollar link had the advantage of instilling stability in relation to the most important foreign currency (i.e. the U.S. dollar) from the aspect of trade and other transactions. Stability facilitated forward planning by South African traders in the foreign exchange market.

However, maintaining the rand/U.S. dollar link had serious drawbacks. The rand was forced to follow the value of the U.S. dollar in terms of the major currencies. A depreciation in the value of the U.S. dollar, and therefore the rand, implies that South Africa will be subject to inflationary pressures due to the effective depreciation of the rand. This may occur in a period when the balance of payments position is favourable and the domestic economy is experiencing a relatively high level of employment.

Alternatively, if the U.S. dollar appreciates in a period when South Africa is experiencing balance of payments difficulties and the domestic economy is in a recessionary phase, then the effective appreciation of the rand will exacerbate the pressures on the local economy, as exports become less competitive and the cost of imports are reduced. Reduced exports and increased imports will result in further pressures on South Africa's balance of payments.

A major problem with a fixed pegged exchange rate is that any economic adjustment due to changed circumstances flows through the domestic economy and not through the exchange rate. The maintenance of a fixed exchange rate becomes a major policy objective, and this may be at the expense of the domestic economy, which bears the brunt of the required adjustment.

For example, if South Africa is experiencing a balance of payments surplus the Reserve Bank, to protect a fixed exchange rate, will need to purchase U.S. dollars and sell rands. The effect is that the balance of payments surplus is translated into an increase in the money supply with resultant inflationary effects. Therefore, the domestic

economy bears the adjustment via an increase in prices rather than an increase in the value of the rand.

If South Africa is experiencing a balance of payments deficit, the Reserve Bank is obliged to sell U.S. dollars at a fixed rate rather than allow the rand to depreciate. The purchase of rands by the Reserve Bank to defend the pegged exchange rate, means that the required adjustment occurs in the domestic economy, as the reduction in the money supply will translate into reduced levels of economic activity and employment.

The sale of U.S. dollars will also result in a decline in the Reserve Bank's foreign currency reserves. The Reserve Bank will only be able to afford a temporary decline in foreign reserves; if the Reserve Bank experiences a continual reduction in its foreign currency reserves, it will eventually be compelled to devalue the rand against the U.S. dollar.

Therefore, a continual decline in foreign reserves will lead to speculative capital outflows that will exacerbate pressures on the Reserve Bank to devalue. This is due to the fact that private operators would be able to predict

with some accuracy when it will be necessary for the authorities to alter a fixed exchange rate (Rees, 1979: p.93).

Leads and lags effects occur which will further reduce the Reserve Bank's foreign currency reserves. Importers will lead payments as the rand is expected to devalue and therefore will wish to pay their foreign currency obligations before any devaluation occurs to the value of the rand. This will result in an increase in demand for spot U.S. dollars.

Exporters on the other hand will hold back on foreign currency receipts until devaluation, in order to earn higher rand revenues. This results in a reduction of foreign currency being supplied to the market. The actions of importers and exporters will result in a decline in the Reserve Bank's foreign currency reserves. A pegged exchange rate therefore implies opportunities by firms to make relatively risk-free speculative profits.

The Commission concluded that a more frequent adjustment to the rand/U.S. dollar exchange rate would still have a serious drawback in that it would be difficult for the

authorities to determine what the "equilibrium rand-U.S. dollar exchange rate really was" (Commission of Inquiry, Interim Report, 1979 : para. 87).

It would be preferable to allow the rand to find its own value in an open and competitive market.

Another serious drawback to a fixed rand/U.S. dollar peg is that the government is seen as directly responsible for any adjustment to the rand/U.S. dollar peg. As a downward adjustment tends to be perceived as a result of government failure, devaluation is resisted until absolutely necessary.

At the time the Commission prepared its report, the spot market did not represent an efficient and competitive market. This was due to the fact that the Reserve Bank set the exchange rate, and any adjustment to the rand/U.S. dollar peg was determined by the Reserve Bank.

Further, the buying and selling rates of the authorised dealers were set by the Reserve Bank and the fixed bid-ask spread was material in relation to other relatively competitive foreign exchange markets. The fixed bid-ask

spread was 0.5 percent (Commission of Inquiry Interim Report, 1979 : para 74, see also, R.M. Gidlow, 1980: p.15) and this compared to spreads of 0.09-0.18 percent which were found in major overseas markets (McCormick, 1979 : p.414).

There were other important factors which curtailed the development of an efficient foreign exchange market. Authorised dealers were not permitted to maintain open positions above a certain minimum level in foreign currency; any foreign currency exposures were required to be eliminated at the close of each day. This restriction limited the ability of South African banks to transact on the Euro-dollar market and give depth to the foreign exchange market.

If the banks were permitted to hold positions in foreign currencies, then this would result in more active trading by the banks in foreign currencies, as positions would be taken based on expectations of future movements in currency values.

Due to the fact that the Reserve Bank handled the sale of gold bullion, and paid the gold mining industry in rands,

it acquired large holdings of U.S. dollars directly. This created a serious imbalance in the foreign exchange market as the banks were net buyers of foreign exchange.

This is due to the fact that the demand for foreign currency to pay for imports was channeled through the banks while an important part of export proceeds, the proceeds on gold bullion sales, Krugerrands and diamonds did not flow through to the banks.

The Reserve Bank was therefore a net seller of foreign currency in the market and was therefore in a powerful position to strongly influence the rand/U.S. dollar exchange rate. The direct flow of U.S. dollars to the Reserve Bank resulted in lower volumes traded in the foreign exchange market and this reduced the depth of the market. A precondition for an efficient forward market is a competitive and efficient spot market. At the time of the Commission of Inquiry's Interim Report a competitive spot market did not exist.

2.2.3 THE FORWARD MARKET

At the time of the Commission of Inquiry's Interim Report in 1979, the forward exchange market was a highly regulated market. Reserve Bank policy was to provide forward cover on transactions involving the movement of goods. The Reserve Bank would purchase forward U.S. dollars from exporters; however the foreign currency receipts should normally accrue within six months.

The forward rate was set by the Reserve Bank in relation to the spot value of the rand. Importers and exporters paid a fixed commission of one percent per annum. Therefore, forward rates were not determined by market factors and did not normally reflect covered interest parity. In an efficient market covered interest parity should hold, so that risk-free profit opportunities are quickly eliminated.

The covered interest parity theory states that the forward premium/discount should reflect the interest differential between observed currencies so that opportunities to undertake covered interest arbitrage transactions are quickly eliminated. In Chapter 5 the validity of the covered interest parity theory is tested in the South

African foreign exchange market for the post-Commission of Inquiry period.

A fixed commission of one percent per annum resulted in two prices for forward U.S. dollars. Apart from a small spread between buying and selling rates, there is usually one price for forward currency in an efficient and competitive market.

The tendency of the authorities to implement adjustments to the rand/U.S. dollar exchange rate based on the state of the balance of payments and the Reserve Bank's foreign exchange reserves led to speculation not only in the spot market but also in the forward market. A fixed rand/U.S. dollar peg and a persistent decline in the Reserve Bank's foreign exchange reserves will lead to general expectations of a downward adjustment to the pegged rand/U.S. dollar exchange rate. This impacts on the forward market, for if general expectations are that a devaluation is imminent, only importers will normally take out forward cover. Exporters will have no incentive to take out forward cover as devaluation will result in an increase in rand revenues.

This resulted in an imbalance in the forward market due to the increase in demand for forward U.S. dollars from importers but a reduction in the supply of forward U.S. dollars by exporters. The Reserve Bank was a net seller of forward U.S. dollars, and was therefore subject to huge foreign exchange losses on its forward exchange account if a devaluation occurred.

The structural imbalance in the spot market was due to the fact that the U.S. dollar proceeds on gold bullion sales flowed directly to the Reserve Bank, and this was matched by a similar imbalance in the forward market. In the spot market the banks were net buyers of U.S. dollars to sell to their clients. The banks were also net buyers of forward U.S. dollars to meet client demand for forward cover against future foreign currency obligations.

The Reserve Bank would be able to avoid exposure on forward sales of U.S. dollars if it deposited the necessary U.S. dollars in the Euro-dollar market until the maturity date of its forward cover obligations. However, the state of the Reserve Bank's foreign reserves did not allow it to avoid exposure to losses on its forward account (Ross, 1980 : p.11).

The Reserve Bank on behalf of the government granted forward cover to the parastatal organisations on foreign borrowings, not only in U.S. dollars but also in the other major currencies. The government created an incentive for parastatal organisations such as ESCOM and SATS to borrow in "hard" currencies such as the deutschemark as these loans carried lower interest rates. Foreign exposure to a likely appreciation in the value of these currencies was carried by the Reserve Bank, and ultimately by the taxpayer.

Parastatal organisations would eliminate exposure to foreign exchange losses by purchasing forward foreign currency at a low fixed cost (i.e. one percent). The imbalance in the Reserve Bank's forward account resulted in the incurrence of foreign exchange losses amounting to billions of rands (see, Foreign Exchange Desk, 1980 and Gidlow, 1986[b] : p.252).

The losses on the forward account, which represented cash flow items, were offset against revaluations of the Reserve Bank's gold reserves, which represented a book entry (Gidlow, 1986[b] : p.252). This practice was limited to

the extent that there were upward movements in the gold price. The practice of offsetting forward exchange losses against the revaluation of the Reserve Bank's gold reserves reflected an effective reduction in the net value of the country's gold and foreign exchange reserves.

The valuation of the Reserve Bank's gold reserves at a nominal figure was replaced by the valuation of the gold reserves at an amount that was close to market value. However, due to the set-off of forward exchange losses, the change in net book value was insignificant, though in reality, the net value of the Reserve Bank's gold reserves declined. Further, the valuation of the Reserve Bank's gold reserves at market value implied that the reported value of the gold reserves were subject to movements in the market price of gold bullion.

The fixed commission charge of one percent per annum did not reflect covered interest parity. Deviations from interest parity resulted in changes to financing policies and created risk-free profit opportunities for firms to enter into covered interest arbitrage transactions.

In order to protect its foreign exchange reserves, the Reserve Bank was able to encourage South African importers to make use of foreign trade credits rather than use domestic borrowings to finance imports. If domestic interest rates were higher than foreign interest rates, then by setting a forward premium which is less than the interest differential, the Reserve Bank was able to influence importers to use foreign trade credits as this resulted in an effective minimisation of financing costs.

For example, if domestic interest rates were 12 percent, foreign interest rates were 8 percent and the cost of forward cover was one percent, then importers would prefer to make use of foreign trade credit finance with an effective cost of about 9 percent per annum, which compared favourably to a cost of 12 percent per annum if importers undertook domestic finance to pay for imports. The Reserve Bank's policy of setting the cost of forward cover at less than the interest differential had positive effects for the Reserve Bank's foreign exchange reserves but further accentuated the imbalance in the forward account.

In an efficient market covered interest parity should occur; however the adoption of a policy to allow forward

rates to reflect interest differentials would result in adverse effects on the Reserve Bank's foreign exchange reserves. This would be due to a switch from the use of foreign trade credits to domestic borrowings.

Another serious deficiency with the forward exchange market was due to the limitations that the Reserve Bank placed on providing forward cover on foreign currency transactions. For instance, private sector investors were not able to obtain forward cover on capital repayments of foreign loans, on interest payments, and on royalties and dividends due in foreign currency. This acted as a serious disincentive for foreign investment as currency exposure could not be avoided. The encouragement of foreign investment was seen to be of importance in relation to the objectives of promoting economic growth and employment. The Commission therefore recommended that the provision of forward cover be extended to foreign loans (Commission of Inquiry Interim Report, 1979 : para. 221).

2.2.4 EXCHANGE CONTROL

The Currency and Exchanges Act, No. 9 of 1933 formed the statutory authority for the adoption of exchange control regulations. The authorities implemented a wide ranging system of exchange controls in 1961. The objective of the various direct and other controls was simply to reduce the demand for foreign currency and remove the "destabilising" effects of capital flows from the balance of payments. Exchange controls would be expected to result in a more favourable exchange rate and alleviate the pressures upon the Reserve Bank's foreign currency reserves.

The Commission found that the exchange control regulations were not always effective in protecting the foreign currency reserves. This may be reflected by the significant unrecorded short-term capital outflows within the balance of payments statistics. The "errors and unrecorded short-term capital flows" item in the balance of payments, which reconciles changes in reserves to recorded transactions, amounted to R585m in 1977 as compared to the Reserve Bank's total reserves of R837m at the time (Kantor, 1978 : p. 67).

This implied that exchange control led to an effective redistribution of wealth as certain parties were able to circumvent exchange control. Therefore, "exchange control harms some individuals for the benefit of others" (Kantor, 1978 : p. 66).

The ordinary investor was not able to obtain the benefits of international diversification. For instance, Mutual Funds were not permitted to deposit funds offshore. Some measure of indirect international diversification could be obtained by investing in local companies with overseas operations. The Commission found that the exchange control regulations acted to discourage foreign investment (Commission of Inquiry Interim Report, 1979 : p.17).

2.3 RESTRICTIONS IN THE FOREIGN EXCHANGE MARKET

The system of direct controls represented a direct interference in the market mechanism and reflected a major departure from market efficiency in terms of the effect that such controls had on economic freedom.

The following represents a list of the major controls that restricted the freedom of economic choice at the time of the Commission report:

1. The Reserve Bank placed restrictions on the number of dealers that were permitted to transact in foreign exchange. Authorised dealers comprised major South African banks. There were no foreign exchange brokers. Therefore, the Reserve Bank limited the number of parties in the market.

2. The Reserve Bank set the buying and selling rates to the public. The authorised dealers were obliged to quote the Reserve Bank's prescribed foreign exchange rates to the public. At the time of the Commission Report the pegged bid-offer rates quoted to the corporate sector and the public was \$1.1471-\$1.1529. This represents a spread of 0.5 percent(58 points) which is wide in relation to other major foreign currency markets. The wide spread represented a major transaction cost imposed on parties trading in the market.

3. Authorised dealers were able to obtain preferential rates from the Reserve Bank for the purchase and sale of

U.S. dollars. The Reserve Bank quoted a spread of 0.25 percent to the authorised dealers. This policy enabled the dealers to earn 0.125 percent on U.S. dollars purchased from (sold to) the Reserve Bank and sold to (purchased from) the public. The fact that a limited number of parties were able to obtain preferential rates represented an inefficiency in the foreign exchange market.

4. The authorised dealers were not permitted to maintain open foreign currency positions. Dealers were required to cover positions at the end of each working day. This regulation had a negative affect on the economic freedom of the dealers to manage their portfolio of foreign currencies based on expectations of future movements in exchange rates.

5. Dealers were not permitted to hold foreign exchange assets unless permission was obtained from the Reserve Bank. This regulation also applied to other South African residents. The Reserve Bank would normally, by arrangement, allow the dealers and other South African residents to hold limited amounts of foreign currency as working balances.

6. South African exporters and residents were required to sell foreign currency proceeds within seven days of receipt.

7. The foreign currency proceeds on the sale of gold bullion, Krugerrands and diamonds did not enter the foreign exchange market directly. Mining companies were not permitted to receive the U.S. dollar proceeds of gold and diamond sales. These U.S. dollar proceeds flowed directly to the Reserve Bank who then paid the mining companies in rands. This policy created an imbalance in the foreign exchange market. The authorised dealers experienced strong demand for foreign currency from importers and other parties. However, the market did not receive directly the U.S. dollar proceeds from gold sales.

Dealers found themselves short of U.S. dollars and were therefore net buyers of U.S. dollars from the Reserve Bank. This policy enabled the Reserve Bank to exercise a strong influence in the market. It also impacted on the economic freedom of the mining houses as they were obliged to accept the exchange rate set by the Reserve Bank. In a free market the mining houses would have been able to offer their U.S. dollars to several buyers and would therefore be

in a position to negotiate a more favourable rand/U.S. dollar exchange rate. Dealers were obliged to be net buyers of foreign currency and therefore were obliged to accept the U.S. dollar offer rates set by the Reserve Bank.

8. The Reserve Bank pegged the value of the rand to the U.S. dollar. This meant that changes in conditions or expectations would be reflected as changes to the Reserve Bank's foreign currency reserves rather than as changes to the exchange rate, as would occur in a free and efficient market. A persistent decline in reserves led to a general expectation that the authorities would be obliged to alter the rand/U.S. dollar peg. This resulted in leads and lags and other speculative capital flows. An effective redistribution of wealth occurred as only exporters, importers and other transactors in foreign exchange were in a position to undertake leads and lags and other relatively risk-free speculative activities.

9. The provision of forward cover was limited to transactions involving the movement of goods. Therefore, no forward cover was provided on foreign loan repayments, interest, royalties and dividend payments.

10. The Reserve Bank set the forward margins at arbitrary levels. The cost of forward cover was set at one percent per annum and this applied to exporters and importers. In an efficient market the cost of forward cover should reflect covered interest parity. This did not apply in the South African forward market.

11. Public corporations were granted forward cover on foreign loans at a cost of one percent per annum. This policy reflected an economic inefficiency and resulted in an effective redistribution of wealth. Public corporations minimised their interest costs (by borrowing in strong currencies) while the Treasury was liable for the resultant major losses incurred on the forward account.

12. The Reserve Bank did not lay off the exposure on its forward account by purchasing foreign currency spot to cover forward sales. This placed the Treasury ("the taxpayer") at risk to exchange rate fluctuations. Dealers were permitted to hold only limited foreign currency balances and therefore were not prepared to carry exposure to losses on forward transactions.

13. The dual exchange rate system resulted in two exchange rates. The significant financial rand discount created incentives for traders to undertake "roundtripping" operations.

14. The Reserve Bank restricted the degree of local borrowing by foreign controlled companies. This was in terms of Regulation 3(1)(f) of the Exchange Control Regulations. This policy had a significant effect on the financial management of foreign controlled companies due to the wide definition given to local borrowing ("financial assistance").

15. In terms of the Exchange Control regulations direct equity investment (in unlisted securities) occurred via the Commercial rand while divestment occurred via the Financial rand. The large Financial rand discount discouraged foreign direct equity investment. This ruling created an unfair advantage for listed investments (which were invested via the Financial rand) in relation to unlisted investments.

16. The extensive system of exchange control regulations impacted on the economic freedom of residents.

Strict limits were placed upon the allocation of foreign currency for purposes such as travel and studies abroad by South African residents. Strict limits were placed on the amount of assets that could be transferred by emigrants.

17. Applications for foreign currency required for specific transactions were submitted directly to the exchange control authorities. Each application was considered on its own merits. This policy resulted in the Reserve Bank allocating foreign currency on an ad hoc basis. Therefore, discretion became an important factor in determining foreign currency allocations. Individuals entrusted with the administration of exchange control wielded significant levels of power and this created opportunities for the misuse of such discretion which is a basic tenet of Exchange Control. This also resulted in high administration costs.

18. The operation of Exchange Control resulted in significant information costs. This is due to the fact that the public were not given free access to the Exchange Control regulations. Amendments to the Exchange Control rulings were promulgated via circulars to the authorised

dealers. Therefore access to the regulations was restricted.

19. Companies, banks and other institutions were not permitted to invest in foreign securities. This prevented South African investors from achieving the benefits of international diversification.

20. Residents involved in the production of goods and services could obtain permission to extend their operations overseas via direct investments. However, the Reserve Bank placed stringent preconditions before granting residents permission to undertake foreign direct investments.

21. Exchange control resulted in high transaction costs for firms involved in normal foreign operations. An extensive system of import permits impacted upon the normal operations of importers. Importers needed to provide documentary evidence to an authorised dealer that the goods were received in South Africa. The export of goods is subject to approval by an authorised dealer. Exporters were required to complete an export declaration. Exchange control permission was required for the raising of foreign

loans. The proceeds of export sales must be received in South Africa within six months after date of shipment.

These rulings resulted in economic inefficiencies due to the fact that they inhibited the normal flow of trade and capital.

2.4 CONCLUSION

South Africa experimented with various exchange rate policies in the post Bretton Woods period to 1979. The Commission of Inquiry found that maintenance of a rand/U.S. dollar peg was inefficient due to the fact that this policy resulted in speculative pressures and tied the South African economy to the performance of the U.S. dollar on the world's foreign currency markets. The Commission of Inquiry recommended a managed floating exchange rate system for the rand.

In addition, in the long term, The Commission of Inquiry recommended a unitary exchange rate system for the rand with no exchange control over non-residents. The Commission concluded that the dual exchange rate system

resulted in economic inefficiencies while exchange control measures were not able to protect the country's foreign exchange reserves when the rand came under pressure.

At the time the Commission Interim Report was published in 1979, South African companies, foreign controlled firms, residents and non-residents were subject to an extensive system of exchange controls that significantly impacted on their economic freedom to undertake foreign trade, investment and borrowings.

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CHAPTER 3

DEVELOPMENTS IN THE SOUTH AFRICAN FOREIGN EXCHANGE MARKET SINCE 1979 : REFORM AND REVERSAL

OBJECTIVE

In its Interim Report published in 1979, the Commission of Inquiry reached an overall recommendation that South Africa should adopt a unitary exchange rate system with market determined spot and forward rates for the rand. In order to meet certain objectives the Reserve Bank would intervene in the market as a buyer or seller of foreign currency. The period subsequent to 1979 represented a period of major reforms which resulted in participants in the market achieving significantly higher degrees of economic freedom. The declaration of the partial debt standstill and the reintroduction of major direct controls in September 1985 signified the end of the reform process. The objective of this chapter is twofold; firstly, to analyse developments and changes in the past Commission of Inquiry era and to measure the effects that these developments have had on the economic freedom of market participants, and secondly, to list the restrictions in place so as to provide a background to the statistical tests of efficiency undertaken in Part 2 of the thesis. Economic efficiency and an efficient market, for the purpose of this chapter, is measured and defined as a market that is free of exchange controls and restrictions on traders to transact in foreign exchange.

3.1. ANALYSIS OF DEVELOPMENTS TO THE DEBT STANDSTILL IN 1985

3.1.1 THE SPOT MARKET

The first steps in the reform process materialised when the Reserve Bank continued to quote bid and ask rates to the authorised dealers but varied these rates more frequently. The authorised dealers were no longer obliged to quote prescribed bid-offer rates set by the Reserve Bank. The immediate effect of this policy was a significant narrowing of the bid-ask spread.

The previous fixed spread of 0.5 percent narrowed to 0.1 percent for amounts greater than R2000 (Gidlow, 1980[b] : p.15). This reflected increased competition amongst the authorised dealers to offer clients competitive rates. The significant reduction in the transaction costs incurred by firms dealing in foreign exchange reflected an improvement in economic efficiency.

In September 1979, the Reserve Bank ceased quoting a dealing rate on the Reuter's monitor. Instead, a dealing rate would be quoted to dealers on individual enquiries or

transactions. The Reuter's monitor merely reflected the last transaction's dealing rate by the Reserve Bank.

This represented an essential step by the Reserve Bank in disengaging from the foreign exchange market and encouraged the independent quoting of rates by the authorised dealers. However, at this stage the Reserve Bank did not use the new flexible arrangements to alter the value of the rand as frequently as would be expected to occur in an efficient market. The dealers were also allowed, subject to limits, to trade for their own account. The interbank market was however limited by the open position restrictions placed upon the dealers as a consequence of the Exchange Control regulations.

In order to create a more balanced spot market, and as a further step in the disengagement process by the Reserve Bank from the spot market, the U.S. dollar proceeds of Krugerrand and diamond sales by the mining sector would flow through directly to the market rather than to the Reserve Bank (Commission of Inquiry Final Report, 1984 : para. 11.11). This had the effect of improving the rates obtained by the mining companies as the U.S. dollars were

offered to dealers providing the most competitive bid U.S. dollar rates.

The Reserve Bank decided to reduce the transaction costs in relation to transactions with the authorised dealers by reducing the bid-ask spread from 29 points to 20 points. The reduced spread was still significantly wider than the bid-ask spread of approximately 10 points found in the interbank market.

The inconsistent spreads resulted in economic inefficiencies due to the fact that firstly, if the Reserve Bank's mid-rate was close to the mid-rate in the market, then this would result in dealers not trading with the Reserve Bank as better rates were available in the interbank market. Secondly, if the Reserve Bank quoted either a bid or ask rate which was close to that quoted in the interbank market and the Reserve Bank maintained a 20 point spread, then this would lead to one way business with the Reserve Bank(Gidlow,1980[b] : p.15).

In paragraph 152 of the Commission of Inquiry Interim Report, the commission states that market forces should be allowed to determine the rand/U.S. dollar exchange rate

subject to Reserve Bank intervention. This implies that intervention should be subordinate to market factors in the determination of the exchange rate. Intervention was seen as necessary to smooth out short-term fluctuations in the exchange rate. Although there is ambiguity in the Interim Report on the objectives of intervention, the overall conclusion is that market factors should be the major determinant of the exchange rate (Geldenhuys, 1980 : p.415). In contrast to the system of quoting fixed bid-ask rates, the Commission envisaged a system whereby the Reserve Bank influenced the exchange rate only by intervening in the market as a buyer or seller of foreign currency.

The Reserve Bank was however reluctant to intervene directly in the market during the course of 1979. It was easier to alter the exchange rate by adjusting the quoted bid-ask rates than by altering rates through the mechanism of intervention (Gidlow[b], 1980 : p.17). When it did intervene the Reserve Bank matched intervention with measures which were economically inefficient (Gidlow, 1980[b] : p.17).

The imbalance in the spot market reflected the fact that a large share of the country's export proceeds, namely the

U.S. dollar proceeds from gold bullion sales, flowed directly to the Reserve Bank. Therefore, the authorised dealers were obliged, on a net basis, to purchase U.S. dollars from the Reserve Bank. The dealers would have preferred direct intervention in the market by the Reserve Bank undertaking sales of U.S. dollars at market rates rather than being obliged to purchase U.S. dollars directly from the Reserve Bank at the unfavourable offer rates (due to the large bid-ask spread).

When the Reserve Bank did decide to intervene by selling U.S. dollars in the market, this was accompanied by the Reserve Bank immediately raising its dealing rates which implied that dealers who purchased U.S. dollars from the Reserve Bank and then proceeded to sell U.S. dollars back to the Reserve Bank would incur a loss. This policy resulted in economic inefficiencies as the Reserve Bank misused its position of recipient of U.S. dollars (due to direct controls) to earn risk-free profits at the expense of the dealers.

Intervention fueled expectations that the Reserve Bank would alter its dealing rates. This created uncertainty in the market and the dealers incurred costs in monitoring

Reserve Bank interventions due to the effects this would have on the Reserve Bank's bid-ask rates. Large flows of U.S. dollars into the market would result in an absence of buyers due to the expected upward revision in Reserve Bank rates.

Although the Commission recommended a market related exchange rate system, the exact objectives of the proposed system were not clear. In paragraph 149 the Commission proposes a "system with a managed, market determined rate for an independent and flexible Commercial rand". This represents a contradiction of terms as a market determined rate cannot represent a managed rate. A market determined exchange rate implies a free floating exchange rate system. However, the Commission in its longer term recommendation did not propose a free floating exchange rate system. Therefore, the Commission proposes that the market will provide the signals for movements in the exchange rate, and the Reserve Bank would influence the exchange rate by selling or buying U.S. dollars in the market.

The Reserve Bank expanded the Securities rand mechanism, which became known as the Financial rand, and non-residents were now able to undertake direct equity investments and

acquire the proprietor's interest in South African assets at the Financial rand rate. Non-residents were however required to obtain Reserve Bank approval in the case of direct equity investments. This change in the use of the Financial rand encouraged foreign investment and economic efficiency as direct equity investment and divestment occurred via the Financial rand. This was in contrast to the previous system whereby investment occurred via the Commercial rand and divestment occurred via the Securities rand.

Although the Reserve Bank started adjusting its dealing rates daily, this policy still reflected a form of variable U.S. dollar pegging. The Reserve Bank preferred to simply adjust rates rather than influence rates via intervention in the market. The Reserve Bank however did apply a more flexible system in quoting its bid-ask rates. On 13 July 1981, for instance, the Reserve Bank made approximately 25 changes to its spot bid-ask rates (Gidlow, 1982[a] : p.36).

In 1983 the authorities implemented significant reform measures. The Minister of Finance announced on 5 February 1983 that exchange control would be lifted on non-resident assets on 7 February 1983. This had the immediate effect

of eliminating South Africa's dual exchange rate system and satisfying the longer term recommendation of the Commission of Inquiry Interim Report, namely the institution of a unitary exchange rate system. The lifting of exchange control over non-residents eliminated a major inefficiency in the country's foreign exchange market. As the editorial in the Investment Analysts Journal (1983, p.5) stated:

"The removal of exchange control in respect of non-residents in February was an important step towards the establishment in South Africa of an efficient foreign exchange market."

The dual exchange rate system implied that the authorities had by the imposition and administration of regulations divided the market for foreign currency into two separate markets. This arbitrarily created welfare gains for certain groups and carried welfare costs for other groups. Due to the significant discount on the Financial rand vis-a-vis the Commercial rand, a unitary exchange rate would have historically implied a lower exchange rate. Therefore, the Financial rand system resulted in, *ceteris paribus*, welfare losses for exporters and welfare gains for importers.

The dual exchange rate system created profit opportunities for parties to undertake transactions which would result in leakages to occur from one market to the other. It also resulted in the incurrence of high policing costs by the exchange control authorities and dealers to try and prevent market leakages.

In March 1983, the Reserve Bank raised the overall limit on foreign currency balances held by the authorised dealers to R600 million. This measure added depth to the market as it enabled dealers to maintain positions and transact in foreign currency for their own account. A few foreign exchange brokers entered the market although their operations were subject to rules set by the Reserve Bank.

In late August 1983 the authorities decided that from 5 September, the gold mines would be paid the proceeds on the sale of gold bullion in U.S. dollars, and would therefore be regarded as any other exporter. This implied that the gold mines would have to exchange their U.S. dollar proceeds into rands within seven days of receipt. However, this still represented a major reform as the market would receive a large supply of U.S. dollars directly and

therefore overcome a major structural weakness in the market, that is, the imbalance between the supply and demand for U.S. dollars.

The gold mines were able to negotiate more competitive offer rates in the market as compared to the offer rates quoted by the Reserve Bank. This reform went further than the recommendations set out in the Commission Interim Report. In paragraph 168(f) the Commission expressly did not recommend that the right to the U.S. dollar proceeds on the sale of gold bullion should be transferred from the Reserve Bank to the foreign exchange market.

The Reserve Bank also ceased quoting spot bid-ask rates and would in future influence the spot rate, if necessary, through the mechanism of intervention. Therefore, the Reserve Bank implemented an important recommendation of the Commission Interim Report, that is, the adoption of a managed floating rate system for the Commercial rand.

It has been stated that "the lack of a well developed spot exchange market hampered the development of an active forward market"(Strydom and Dagut, 1979 : p.122). The reverse is also true. The existence of a highly regulated

forward market would limit the development of a free and competitive spot market. In an efficient market there is an effective integration of the spot and forward markets. This results in the equality of financing costs (apart from differences due to transaction costs and capital controls) as indicated by the covered interest rate parity theory. Therefore, the reform measures introduced by the Reserve Bank in the forward market (as explained further in this chapter) represented further steps in the development of the spot and forward markets into active and competitive markets.

By September 1983 the spot market had developed into a relatively competitive market and, if not entirely economically efficient due to the existence of the remaining Exchange Control regulations over residents and foreign controlled companies, the market compared favourably with many first world countries in relation to the degree of economic freedom available to market participants.

The significant reforms in 1983 led to a major increase in the size of the interbank market. The Reserve Bank had ceased prescribing the dealers' rates to the public and

ceased quoting fixed rates in its transactions with the dealers. The bid-ask spreads narrowed considerably. The U.S. dollar proceeds on the sales of gold bullion flowed directly into the foreign exchange market thereby correcting the previous structural imbalance in the market. The dealers were allowed to maintain open positions subject to increased limits. These measures had increased the economic freedom of traders to transact in foreign exchange.

In the course of 1984 the rand depreciated by 38 percent against the U.S. dollar. Movements in the value of the rand became more volatile. Leads and lags effects resulted in a decline in the foreign exchange reserves of the Reserve Bank. The dramatic decline in the rand created political pressures on the authorities to control the exchange rate and thereby reverse the degree of economic freedom implemented in terms of the Commission of Inquiry's Interim Report.

The levels of the Reserve Bank's foreign currency reserves did not enable the authorities to influence the exchange rate through the mechanism of intervention. Therefore,

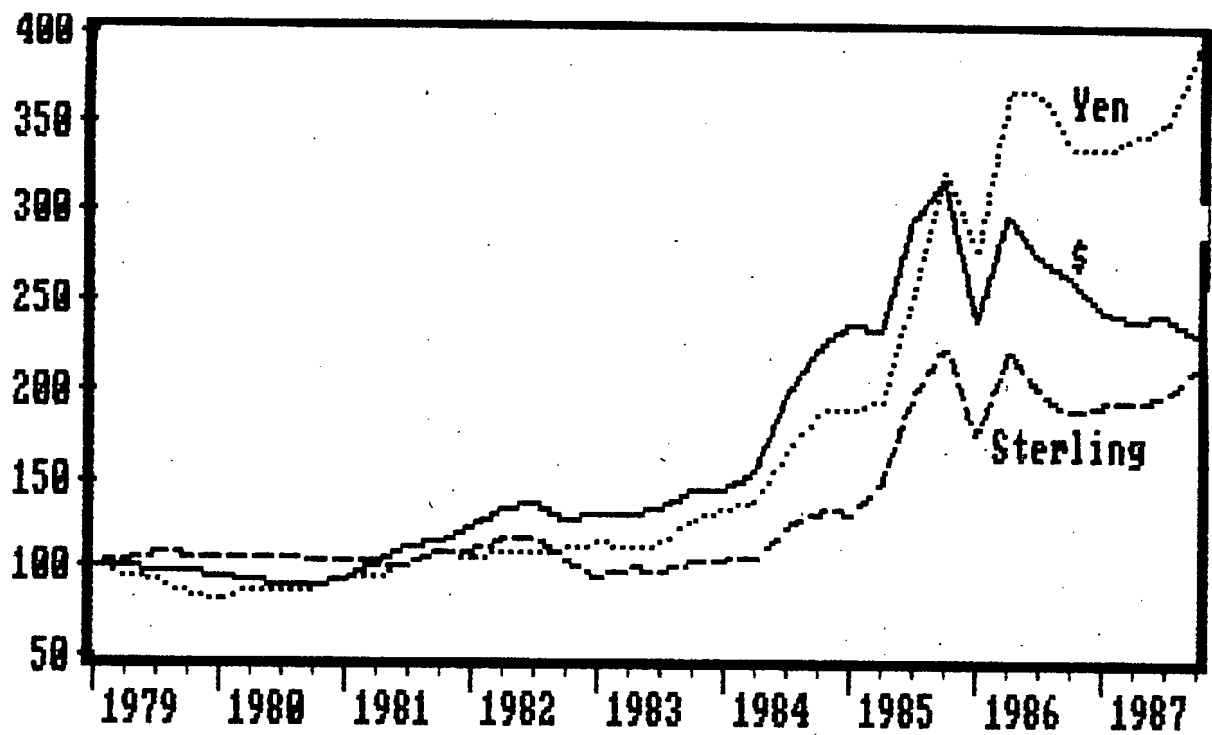
the authorities decided to reinstate certain direct controls.

The first steps in the reversal of the reform process led to the ruling on 30 January 1985 that the Reserve Bank would pay the gold mines half their proceeds on the sale of gold bullion in U.S. dollars and the other half would be paid in rands. The Commission defined this change in policy as a "temporary" measure (Commission of Inquiry Final Report, 1984 : para. 12.4). The objective of the change in policy was to "enable the Reserve Bank to exercise greater influence on the exchange market on a continuous basis at a time of abnormal conditions in the world's foreign exchange markets"(Commission of Inquiry Final report, 1984 : p.126). The volatile behaviour of the exchange rate in a floating rate system has been criticized. Cloete(1986) and Holden and Holden(1985) have proposed a more managed exchange rate to promote price stability.

The movement in the quarterly rand spot exchange rate(direct quotation) against the U.S. dollar, the Japanese yen and British sterling is depicted in Figure 3.1. The end of the first quarter of 1979 represents the

base of 100. As is evident from Figure 3.1, the rand reported a significant decline in relation to the major currencies over the period 1979-1987.

FIGURE 3.1 THE RAND SPOT EXCHANGE RATE : 1979-1987
QUARTERLY DATA (31/3/1979 = 100)



3.1.2 THE FORWARD MARKET

At the time of the Commission of Inquiry's Interim Report the forward market represented a highly regulated market. The cost of forward cover was set at arbitrary levels and did not reflect covered interest parity. Arbitrage activities would ensure that interest rate parity would hold in a free and competitive market. The Reserve Bank also restricted the type of foreign currency transactions for which forward cover was available. The Reserve Bank provided forward cover to the authorised dealers on an outright basis which indicated that forward sales/purchases did not affect the spot exchange rate, although forward transactions would on maturity affect the country's foreign exchange reserves.

In an efficient market dealers would cover their forward exchange liabilities/assets by purchasing/selling foreign currency in the spot market. Therefore, in an efficient market there is an effective integration of the spot and forward markets.

The fact that forward transactions did not directly affect the spot exchange rate represented a major inefficiency in

the South African foreign exchange market due to the size of the forward exchange market. It has been reported that, for instance, in the first quarter of 1981 the total value of foreign exchange transactions between the Reserve Bank and the authorised dealers amounted to R6.8 billion. Of this amount, 59 percent or R4 billion represented forward transactions (Stals, 1981 : p.88).

In the period 1979 to 1985, the Reserve Bank implemented major reforms in the forward market. In April 1979, the Reserve Bank ceased quoting a 1 percent premium for both importers and exporters on forward cover and commenced quoting a 2 percent discount for importers and a 2 percent premium for exporters.

The Reserve Bank therefore removed the practice of quoting two prices for the same commodity. The 2 percent forward cost/benefit reflected the interest differential between South African and U.S. rates at the time (Ross, 1980. : p.9).

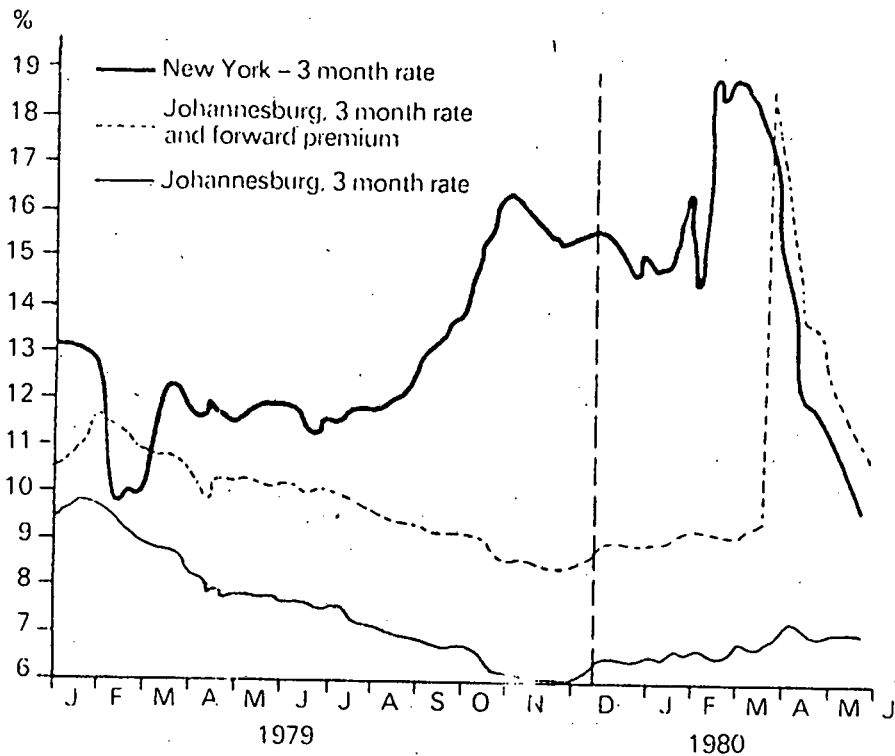
In the period May 1979 to April 1980, the Reserve Bank set the three month forward rate at 2.5 percent per annum (i.e. the forward U.S. dollar rate was at a discount of 2.5

percent against the spot rate). This was despite the fact that the interest differential between South Africa and the USA had widened considerably during the same period. South African rates had declined while the U.S. rates had increased.

This prompted importers to pay immediately for imports due to the low effective cost of financing. Ross (1980, p.12) states that importers requested discounts which were;

"pitched at a level which took into account the cost to the importer of financing himself in South Africa for this additional period, but nonetheless made it attractive for the foreign exporter to receive cash at an earlier stage and thereby reduce his (very expensive) foreign overdraft."

The material difference between the cost of local and foreign trade finance (including the cost of forward cover) until March 1980 is depicted in Figure 3.2.

FIGURE 3.2 FOREIGN vs LOCAL TRADE FINANCE COSTS

(Source : Ross, 1980)

Exporters and importers "set about changing their terms of trade to take advantage of what became increasingly attractive means of financing South African trade" (Ross, 1980 : p.11). The increase in U.S. rates and the decline in local interest rates, combined with a forward U.S. dollar discount that was substantially less than the difference in U.S. and South African rates meant that exporters were in a position to grant foreign customers extended credit terms at low cost. Importers were

encouraged to pay for goods immediately due to low domestic interest rates. Foreign suppliers appreciated early payment due to the high cost of financing in foreign centres. Mutual benefits could be apportioned through the pricing mechanism.

The increase in the U.S. dollar price of gold led to a significant inflow of liquidity. The Reserve Bank's forward policy of setting the U.S. dollar discount at a rate substantially less than the interest differential had the counter effect of encouraging foreign currency outflows due to the fact that importers were encouraged to pay immediately while exporters were encouraged to grant extended credit terms.

Although this policy may have countered to some degree, the inflationary effects of the liquidity inflow, it affected economic efficiency through its discretionary welfare effects. In a floating exchange rate system foreign currency inflows would be compensated by an increase in the exchange rate. The Reserve Bank was unwilling to allow the rand to appreciate to the level required and therefore manipulated the forward exchange rate. The effect was that South African consumers did not fully benefit from the

potential supply of less expensive imported goods. Exporters benefited due to a lower exchange rate. The maintenance of low interest rates indicated that borrowers benefited at the expense of lenders.

The imbalance in the forward market and the provision of forward cover to the parastatal organisations on offshore borrowings at low cost resulted in significant foreign exchange losses on the Reserve Bank's forward account. The Reserve Bank followed the dubious accounting procedure of setting off losses on the forward account, which represented a cash flow item, against the revaluation gains on the Reserve Bank's gold reserves which represented a book entry. The Reserve Bank is estimated to have lost R2 billion in providing forward cover facilities to parastatal organisations as well as the private sector in the year to March 1985 (Gidlow, 1986[b] : p.252).

From December 1979 the Reserve Bank commenced quoting forward cover to the public sector only on the rand/U.S. dollar leg of foreign transactions. Forward cover on the U.S. dollar/third currency leg was arranged through the authorised dealers who obtained the required forward cover on overseas foreign exchange markets. This precluded the

parastatal organisations from borrowing in the hard currencies like the deutschemark and Swiss franc at an effectively low financing rate (including the cost of 1 percent per annum on forward cover) while the Treasury carried significant losses due to the appreciation of these currencies.

The change in policy led to an improvement in economic efficiency due to the fact that the favourable forward cover policy granted to the parastatal organisations influenced the decision to obtain finance in centres different to that if the forward rate was set in an efficient market. This was due to the fact that the major cost of obtaining finance in these centres (the risk of currency appreciation) was borne by the Treasury (i.e. the taxpayer).

In April 1980, the Reserve Bank increased its three month forward cover rate from 2.5 percent to 12 percent per annum. As depicted in Figure 3.2, this reflected, the interest differential between U.S. and South African interest rates. Therefore the costs of financing were equalised over the two currencies.

In December 1980, the Reserve Bank commenced quoting a full range of forward maturities. The Reserve Bank manipulated forward margins for specific maturities to "encourage or discourage covered foreign financing in the selected maturities" (Commission of Inquiry Final Report, 1984 : para.11.20). The Commission further states in paragraph 11.20 that,

"the rate for the forward U.S. dollar was at times set at a level that was more attractive to importers than to exporters, so that the Bank tended to sell more U.S. dollars forward than spot."

The former statement implies that the Reserve Bank's forward margins did not reflect interest differentials thereby creating opportunities for parties to engage in profitable covered interest arbitrage activities. Therefore, importers and exporters would finance trade from either domestic or foreign sources depending on the relative costs of financing (including the cost of forward cover) in each centre.

The latter statement implies that the Reserve Bank followed a policy of setting the forward U.S. dollar discount at a rate greater than that indicated by interest differentials. Local interest rates were lower than U.S. rates at the time. Importers would prefer to use foreign trade credits and undertake a forward contract rather than borrow from local sources, if the forward U.S. dollar discount more than offset the higher foreign interest rates. This indicated a reversal of the previous policy during the course of 1979 and early 1980 of setting the forward U.S. dollar discount at a rate significantly less than the interest differential.

The above Commission statements are incomplete. Firstly, the Reserve Bank would be a net seller of forward U.S. dollars due to the structural imbalance in the market. Secondly, if general expectations were that the rand would not appreciate to the extent indicated by the forward U.S. dollar discount then importers would gain by purchasing forward U.S. dollars at a more favourable rate.

The Reserve Bank's forward policy reduced the immediate pressures on its foreign exchange reserves. However, it also meant that the increase in forward commitments may not

have been reflected in the spot rate. Forward sales affected the foreign exchange reserves at the time the Reserve Bank met its forward commitments rather than at the time of entering into the outright forward deals. If the market is efficient, then it can be argued that the current spot rate will immediately reflect the effect that forward sales will have on the future spot rate. However, the fact that the authorised dealers bought the required forward U.S. dollars on an outright basis and were precluded from purchasing the foreign currency on the spot market due to Exchange Control regulations, meant that the spot market was not directly affected by these forward sales.

Although the spot exchange rate is not directly influenced by forward transactions, changes in the Reserve Bank's foreign exchange reserves may lead to a revision in expectations about future spot rates and this would thereby influence the current exchange rate. In Chapter 7, we test the relationship between changes in the spot rate and changes in the Reserve Bank's foreign exchange reserves. Tests indicate that a positive, statistically significant relationship exists between these two variables.

In September 1983, the authorities introduced a spot/swap system of forward exchange. This was in contrast to the previous system of the Reserve Bank granting forward cover to the authorised dealers on an outright basis on their net forward positions. In terms of the spot/swap system, dealers were obliged to obtain forward cover on their net forward U.S. dollar sales commitments by purchasing the required amount of U.S. dollars on the spot market.

Dealers would then be obliged to arrange a swap transaction whereby these U.S. dollars would be sold spot and simultaneously purchased forward. Dealers were encouraged to arrange the necessary swap transactions in the market, however, the Reserve Bank would be prepared to enter into the required swap transactions with the authorised dealers if this was not possible. This was the likely position due to the structural imbalance in South Africa's foreign trade, whereby most of the export sales proceeds are received immediately while imports are purchased on credit.

The spot/swap system represented an attempt to simulate an efficient and competitive market without ordering the required dismantling of Exchange Control. Forward transactions had an immediate effect upon the spot exchange

rate. This was in contrast to the previous administered system whereby forward sales did not directly affect the spot exchange rate.

Further, although the authorities were able to simulate an efficient market by for example setting the cost of forward cover on the basis of interest differentials, economic efficiency was not fully achieved. This was due to the fact that the arrangements still carried the risk of loss to the Treasury if the Reserve Bank's forward commitments were not covered by the Reserve Bank depositing the required foreign currency amounts in the Eurodollar market.

An efficient and competitive forward market "is based on the access of both residents and non-residents to deposit markets in the relevant currencies" (Gidlow, 1984[d] : p.249). If a bank sells \$10 million six months forward in exchange for delivery of rands at that time, then in terms of this transaction the bank will be short \$10 million and long in rands. To cover its foreign exchange position, the bank will borrow rands and purchase \$10 million on the spot market. The bank would then invest \$10 million in the Eurodollar market until the maturity date of the forward contract in six months time.

The difference in interest paid and interest received will be charged to the client as the cost of forward cover. This explains why the cost of forward cover should reflect interest differentials.

The Exchange Control limits on maintaining open foreign currency positions precluded the dealers from purchasing U.S. dollars spot to cover net forward U.S. dollar commitments and depositing these funds in the Eurodollar market. The swap facility granted by the Reserve Bank to the dealers, to purchase (on balance) spot U.S. dollars and simultaneously sell forward U.S. dollars, represented a major improvement in economic efficiency as forward transactions had a direct effect on the spot rate.

However, the Treasury still carried losses on the Reserve Bank's forward account as the Reserve bank, due to the state of its foreign exchange reserves, was unwilling to cover its position by purchasing the amount of net foreign currency forward commitments in the spot market.

The state of the Reserve bank's foreign exchange reserves played a central role in the decision by the Commission not to recommend the immediate creation of a developed forward

exchange market. It was stated that such a development would have an "undue strain" on the official foreign reserves (Commission of Inquiry Interim Report, 1979 : para. 212). However, under a free floating exchange rate system, the adjustment would occur through the exchange rate rather than through the reserves. Foreign exchange reserves are needed only when the rate of exchange is kept above its market value (Rees, 1979 : p.93)

According to Geldenhuys (1980, p.418) the lack of development of a competitive forward market in South Africa was due to the fact that the rand was not a;

"truly internationally accepted currency. Because foreign banks will not readily sell U.S. dollars, German marks (DM), sterling, etc., against rand on a large scale, local banks are just not in a position to arrange direct and forward cover internationally. These circumstances leave no alternative but for the Reserve Bank to be provider of forward cover against at least one foreign currency. The most efficient way in which to do this is to simulate

the conditions that would prevail in a true forward market"

In the period 1983 to 1985 the forward market developed into a more competitive market with the banks undertaking swap and forward transactions in the interbank market rather than the previous situation where all forward transactions were undertaken with the Reserve Bank. Dr R.M. Gidlow of the Reserve Bank and Mr C. Viettri of First National Bank confirmed that, except for the debt standstill, the forward market would have developed into a "competitive" market ¹.

The Reserve Bank entered into a quota system whereby the Reserve Bank would be able to disengage itself from the forward market by 31 August 1986. This would enable the Reserve Bank to limit its exposure to losses on the forward exchange account. The Reserve Bank entered into swap quota agreements with the authorised dealers whereby the Reserve Bank would provide each dealer with forward exchange up to the quota limit.

1. Private interviews with the writer in Pretoria (8/7/86) and Johannesburg (9/7/86).

The swap quota agreements totalled R10 billion but this amount would be reduced to nil by equal amounts over three years. It was envisaged that after 30 September 1986 the Reserve Bank would no longer provide forward cover to the authorised dealers, and losses would be limited to intervention undertaken by the Reserve Bank in the forward market. Forward rates would be market determined.

The reversal of the reform process occurred due to the dramatic decline in the rand/U.S. dollar exchange rate. In order to limit the pressures on the spot exchange rate the authorities decided to offer a dual forward exchange facility on the sale of U.S. dollars by the Reserve Bank. Authorised dealers were able to obtain forward cover either through a swap arrangement or else through the purchase of forward U.S. dollars on an outright basis. Swap transactions placed direct downward pressures on the spot exchange rate, while the outright sale of forward U.S. dollars did not involve the purchase of U.S. dollars in the spot market.

The Reserve Bank encouraged the dealers to purchase forward U.S. dollars on an outright basis by setting more favourable forward rates on forward U.S. dollars sold on an

outright basis compared to forward U.S. dollars sold under the swap arrangements. The Reserve Bank by encouraging outright deals vis-a-vis the swap arrangements, reduced to some degree the downward pressure on the spot rand/U.S. dollar rate.

Gidlow (1985, p.227) states that,

"The dual exchange rate system was partly justified on the grounds that leads and lags had depressed the rand unduly, and action was warranted to reverse this trend"

This policy represented a departure from the stated policy of allowing the exchange rate to be market determined. The Reserve Bank manipulated the price of forward cover in order to increase the value of the spot exchange rate.

This resulted in a loss in economic efficiency as the dual forward exchange rate policy represented a direct interference in the market mechanism. It precluded the purchase of forward U.S. dollars from directly influencing the spot rate. However, the increase in forward commitments by the Reserve Bank could lead to expectations

that the rand would further depreciate in the future, and this could result in downward pressures on the spot rate. For example, the fact that significant forward commitments were to be met within a certain time period, may lead importers to pay immediately while exporters would prefer to lag foreign currency receipts.

The dual forward exchange rate policy also resulted in two prices being quoted for the same commodity. This enabled the authorised dealers to undertake arbitrage transactions with the Reserve Bank, and thereby earn risk free profits (Gidlow, 1985 : p.228).

Another inefficiency occurred due to the fact that the forward sale of U.S. dollars by exporters was still conducted by means of spot/swap transactions. Therefore, exporters were placed in a disadvantaged position relative to importers. The increased forward commitments by the Reserve Bank had the effect of increasing the imbalance on its forward exchange account.

Due to the disadvantages of the dual forward exchange policy, the Reserve Bank "within a few weeks withdrew the privilege whereby banks could buy U.S. dollars forward from

it on an outright basis at favourable rates" (Gidlow, 1985 : p.229).

The stated objective of the Reserve Bank to disengage from providing forward cover to the dealers by the September 1986 was based on the implicit assumption that the necessary swap facilities would be available in the interbank market. In the course of 1985 this became an increasingly unrealistic objective. This was due to two reasons; firstly, the structural imbalance in the forward market and secondly, the Exchange Control limits placed on the dealers maintaining open foreign currency positions. The imbalance in the forward market was exacerbated by the Reserve Bank paying to the mines from the end of January 1985 only 50 percent of the proceeds on gold bullion sales in U.S. dollars.

The total limit on dealers holding foreign currency balances amounted to R600 million. This was inadequate in a foreign exchange market where transactions were estimated to total approximately R30 billion. Therefore, the authorised dealers would not be in a position to grant forward cover to traders without Reserve Bank support.

The development of the forward market was hampered by the inability and unwillingness of the authorities to remove Exchange Control. The forward market had become a more active and efficient market in comparison to the position prior to the Commission of Inquiry Interim Report. The cost of forward cover was based upon interest differentials. This should occur in an efficient market.

There were no longer two quoted prices for forward U.S. dollars. The parastatal organisations were precluded from undertaking further foreign borrowings at a low forward cover cost in currencies which would probably appreciate significantly against the rand. However, Exchange Control and the political pressures placed upon the authorities by the decline of the rand prevented the forward market from becoming a free and efficient market.

3.1.3 EXCHANGE CONTROL

The ineffectiveness of exchange control in protecting the foreign exchange reserves and the fact that exchange control acted as a deterrent to foreign investment led the authorities to initiate steps in removing or amending the Exchange Control regulations. Economic efficiency would be enhanced by the market rather than the authorities rationing foreign exchange. The limits on capital transfers abroad by residents and emigrants were raised.

The major reform, however, constituted the lifting of Exchange Control over non-residents thereby effectively abolishing the Financial rand mechanism. The overall limit on the foreign currency balances held by authorised dealers was raised to R600 million. This was, however, still insufficient to enable the dealers to provide the forward cover required by traders in the South African foreign exchange market. Further, foreign assets did not qualify as "liquid assets" in terms of the Bank's Act.

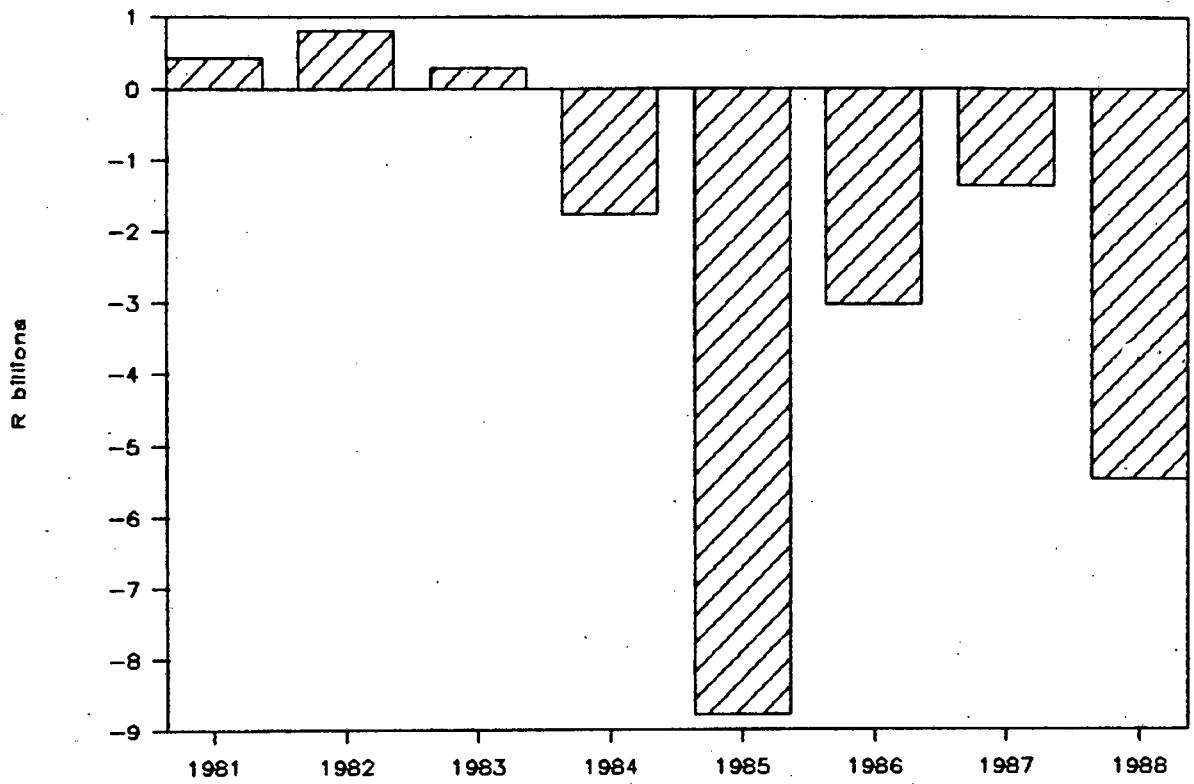
Foreign exchange brokers were allowed to operate in the market (subject to Reserve Bank rules). The Reserve Bank applied a more liberal policy in allocating foreign

exchange for purposes of direct foreign investment by South African companies. The restriction, contained in Section 3(1)(f), on local borrowing by foreign controlled companies was relaxed.

The period 1979 to 1985 reflected a period of exchange control relaxation in terms of changes to the Exchange Control regulations and application of existing regulations. The major reforms occurred in the spot and forward markets, although the authorities preferred to follow a piecemeal relaxation of exchange controls rather than instituting overall changes.

The ineffectiveness of Exchange Control is suggested by the large short-term capital outflows under the item "Private Sector Short-term Capital Flows" which includes unrecorded transactions. The item "Private Sector Short-term Capital Flows" is depicted in Figure 3.3. This item is a balancing figure and may be a measure of "capital flight". The large capital outflows in 1984, particularly 1985, 1986 and 1988 suggest that Exchange Control has not been successful in restricting capital outflows.

FIGURE 3.3 PRIVATE SECTOR SHORT-TERM CAPITAL FLOWS
RANDS(BILLIONS)



3.2 THE FOREIGN DEBT STANDSTILL AND EXCHANGE CONTROL

3.2.1 BACKGROUND TO THE FOREIGN DEBT STANDSTILL

In the course of 1984 the rand depreciated by 38 percent against the U.S. dollar. This placed political pressures upon the Reserve Bank's policy of allowing market factors to determine the rand exchange rate, and added impetus for the re-imposition of direct controls. In 1985 the position was further exacerbated by widespread political disturbances. The imposition of the state of emergency, French sanctions and the "Rubicon" speech in Durban had a materially negative impact on overseas perceptions. The run on the financial system was precipitated by the decision by W. Butler, chairman of Chase Manhattan Bank to call in his bank's short-term loans. This led to other U.S. banks following suit.

The position was exacerbated by the fact the South Africa had undertaken significant levels of short-term debt in the 1982-1984 period. The weak state of the Reserve Bank's foreign exchange reserves further complicated the situation. Capital flowing out of South Africa reached material proportions.

By August 27, the rand had depreciated to U.S. \$0.35. The Reserve Bank and the Government decided to close the foreign exchange and stock markets immediately.

On September 2, the Reserve Bank declared the foreign debt standstill. As Grant (1985), p.73) states;

"South Africa unilaterally applied a freeze on repayments of principal on its foreign debt, for four months, and became the first sovereign debtor to renege on its short-term interbank lines."

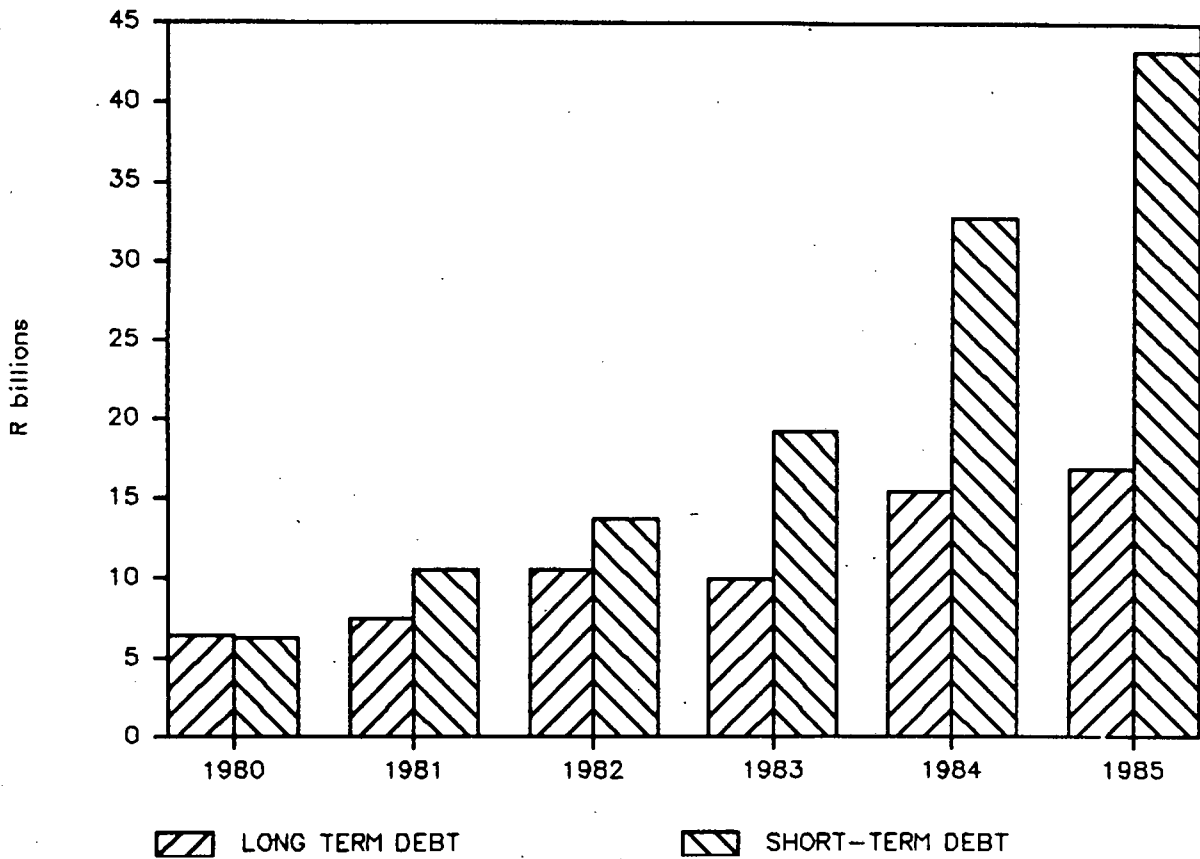
Certain forms of debt were exempt from the standstill including government debt and IMF loans. The total foreign debt was estimated to be \$24 billion of which \$14 billion fell within the standstill "net". Creditors affected by the standstill could decide to either leave the loans in place with the initial borrowers or transfer the loans on to the Reserve Bank to earn a rate of one quarter percent above LIBOR.

The Financial rand mechanism was reintroduced to "curb any possible accompanying outflow of non-resident equity funds" (De Kock, 1986 : p.10). This was matched by the imposition of further direct controls to support the value of the rand.

The debt problem was not due to overborrowing, but due to the structure of foreign debt. In 1977, political disturbances did not have a significant effect on capital withdrawal as the major part of foreign debt constituted long-term loans. In 1985 short-term debt amounted to a significant proportion of South Africa's total foreign debt and this made South Africa "vulnerable to a run on the interbank market"(Grant,1985 : p.68)

Figure 3.4 reflects the changing structure(in rands) of South African foreign debt from 1980 to 1985. In 1980 short-term debt constituted 49 percent of South Africa's total foreign debt whereas in 1985, short-term debt constituted 72 percent of the total foreign debt.

**FIGURE 3.4 THE STRUCTURE OF SOUTH AFRICAN FOREIGN DEBT
RANDS(BILLIONS)**



The foreign debt standstill indicated major weaknesses in the South African foreign exchange market. Certain South African banks had engaged in maturity mismatching,

borrowing short and lending long and had maintained uncovered foreign exchange positions. The sudden withdrawal of foreign credit lines placed these banks in serious financial difficulties. Overseas branches of local banks were closed. The imprudent policies of the banks led to the adoption of a new banking bill which included capital requirements for off-balance sheet liabilities (i.e. banks acting as guarantors for client loans, see De Kock, 1985 : p.12) and applied limits to banks maintaining open foreign exchange positions and mismatching maturities.

The debt standstill and overseas political perceptions resulted in the absence of foreign finance and this represented an effective imposition of capital sanctions. The foreign debt situation also made it imperative that South Africa generate the necessary current account surpluses to generate the foreign currency required to repay the foreign debt.

Political disturbances and economic recession placed pressures upon foreign companies to disinvest. In the three years to March 1987, the number of American firms with factories or offices in South Africa declined from

over 325 to 182 (Beatty and Harari, 1987 : p.32). American companies which decided to "disinvest" included Apple Computer, General Electric, IBM, Rank Xerox and General Motors. The statement by Beatty and Harari (1987) that direct equity investment in South Africa declined from \$2.6 billion in 1981 to \$1.3 billion in 1985 is misleading due to the sharp decline in the rand/U.S. dollar rate over that period. The fundamental fact is that new capital inflows have declined materially.

3.2.2 EXCHANGE CONTROL

The foreign debt standstill was accompanied by the effective reversal of the reform process. Reforms were reversed and further direct controls were reimposed. The introduction of the various reforms had increased economic efficiency as measured by the degree of economic freedom allowed to participants in the foreign exchange market. The imposition of direct controls reflected a loss in economic efficiency as measured by the restrictions placed upon traders and dealers in foreign exchange. The Commission of Inquiry report has become ineffectual and perhaps irrelevant. The following reflect measures which

presently restrict economic freedom in transacting in foreign exchange.

1. Non-residents may invest and disinvest from South Africa via the Financial rand if permitted by the Exchange Control authorities. Permission is not required for investment in quoted securities. As income flows through the Commercial rand, returns to non-residents are magnified in relation to local investors. The dual exchange rate system may create opportunities for gain due to market leakages.
2. The purchase of equity in non quoted companies and the purchase of property by non-residents with Financial rands requires the permission of the Exchange Control authorities. The authorities have recently (August 1989) reversed the policy of allowing non-residents to purchase residential property partly with Financial rands. In other situations, although capital may be transferred in freely via the Commercial rand, disinvestment will occur via the Financial rand.

3. Foreign investment by South African residents, if permission is granted by the authorities, will take place via the Financial rand.
4. Capital transfers by emigrants are subject to limits, and capital retained in South Africa is transferred into a blocked account.
5. Distributions from South African estates is limited to R100 000 which must be made via the Financial rand.
6. Capital transfers from testamentary trusts will occur via the Financial rand while income may be transferred via the Commercial rand. The restrictions upon inter-vivos trusts are severe and applications must be made to the Exchange Control authorities to transfer capital and income.
7. The declaration of dividends to non-residents may only be paid from revenue profits which have accrued subsequent to 1 January 1984. Dividends may not be paid out of profits of a capital nature which include profits on the sale of assets, or revaluation reserves.

8. All foreign debt undertaken by South African residents prior to 28 August 1985 is subject to the debt standstill arrangements. Exceptions to the standstill include public debt repayments, debts to international financial agencies and the loan commitments of the Reserve Bank. If the creditor does not agree to extend the term of the loan with the initial borrower, the amount is required to be paid into a Special Restricted Foreign Currency Account administered by the Public Investment Commissioner.
9. Non-resident account balances with the authorised dealers (prior to 2 September 1985) have been classified as Special Restricted Rand Accounts (SRRA's). These amounts may not be transferred from South Africa in foreign currency. If the balances are of a current nature, R50 000 may be transferred abroad.
10. Prior to 2 September 1985 non-residents could undertake direct investments either through equity capital or loan account. At present, non-residents

are only permitted to undertake direct investments by way of equity capital.

11. The repayment of existing loan accounts requires the permission of the Exchange Control authorities.
12. Current account balances due to non-resident parent companies by local subsidiaries may only be paid if the payment is in respect of goods imported into South Africa. Permission to transfer current account balances requires Exchange Control permission. If a current account balance remains outstanding for longer than a year, the Exchange Control authorities may define the current account as a foreign loan. The company would then find it more difficult to obtain permission to repay the account.
13. Restrictions exist on foreign investments by South African residents. Exchange Control may grant permission for foreign direct investment if the investment meets stipulated criteria. The authorities would require that "the investment will stimulate South African exports, earn additional foreign currency for South Africa, or is necessary in order to

protect a foreign source of supply for South Africa" (Ernst & Young, 1989 : p.10).

14. Importers are required to furnish documentary proof that imported goods have been received in South Africa before the authorised dealers will allow the allocation of foreign currency.
15. Various categories of goods require an import permit. Therefore importers must show that they hold a valid import permit if applicable to the class of goods imported. In addition to normal tariffs, importers are required to pay a surcharge on cost of imported goods.
16. Importers are not allowed to pay for imported goods earlier than the date of shipment. Advance payments, up to one third of the cost, will be allowed for capital imports.
17. A firm that is both an importer and exporter is not allowed to set off foreign proceeds against foreign remittances. Restrictions are placed on the maintenance of overseas bank accounts.

18. Exporters are required to complete an export declaration which is attested to by an authorised dealer. Proceeds of export sales must be received in South Africa within six months of the date of shipment, although credit may be granted up to twelve months if the exporters share of the foreign market is at risk.
19. If an exporter grants trade credit to an overseas customer, then the proceeds must be covered forward for the whole period. An exporter must enter into a forward contract within seven days of shipment.
20. Section 3(1)(f) of the Exchange Control regulations restricts the level of local borrowing (financial assistance) undertaken by foreign controlled companies. Section 3(1)(f) applies to firms where 25 percent or more of the capital, assets or earnings benefit a non-resident or where 25 percent or more of the voting control is vested in a non-resident. A section 3(1)(f) "affected" firm is required to apply for Exchange Control authority for all local "financial assistance" facilities. The definition of

financial assistance is wide and includes overdrafts, leasing, and sale and leaseback. The firm is also required to detail all off-balance sheet finance. The level of local financial assistance allowed to an affected firm is limited to the following formula:

$[50\% + \% \text{ local participation} / \% \text{ foreign participation} \times 50\%] \times \text{total effective capital}.$

Effective capital (shareholders' funds) includes issued share capital, share premium, retained earnings, reserves, deferred tax balances, shareholders' loans to the extent that the balance between resident and non-resident participation is maintained, and dividends declared but not paid.

21. The remittance of dividends by firms which are 25 percent or more controlled by non-residents require Exchange Control authority.
22. Exchange Control authority is required for foreign borrowings by firms operating in South Africa.
23. Interest payments on foreign loans are freely transferable; however, the interest rate must be

reasonable in comparison to local market interest rates.

24. Royalty agreements must be submitted to Exchange Control or the Department of Industries. If the required royalty is less than 3.5 percent of turnover, then the royalty payments will be permitted if underlying "know-how" is provided which benefits the country. Exchange Control will not normally permit royalty payments for the use of patents or trademarks which exceed 0.5 percent of turnover.
25. The payment of management fees to a foreign company requires Exchange Control authority. The applicant must show that the management services are necessary and the fee must be reasonable in relation to the services provided. The authorities will not normally approve the payment of management fees by a wholly owned South African subsidiary to its overseas parent company.
26. Emmigrants are subject to stringent limits on capital transfers. Capital remaining in South Africa is blocked and blocked funds may only be utilised for

specified purposes. Capital transfers take place via the Financial rand.

27. Restrictions apply for the payment of directors' fees, foreign currency allocation for holidays abroad, business travel, and overseas studies.
28. Restrictions also exist for foreign currency allocations for settling legal disputes in foreign countries, tender guarantees, alimony payments, advertising expenditure, technical services and medical expenses.
29. The penalty for contravention of the Exchange Control regulations has been increased from R10 000 to R250 000.

The above points reflect the degree to which economic freedom and, therefore efficiency as defined, are restricted by exchange control over transactions involving foreign currency. Further, the situation is exacerbated by the secrecy surrounding the exchange control regulations. The Exchange Control regulations are subject to amendment by exchange control circulars to the authorised dealers

which are not promulgated in the Government Gazette. This means that the regulations remain a dark mystery to persons outside the banking sector (Chaplin, 1987 : p.623). This policy results in high transaction costs, reflected in the costs of obtaining reliable information.

3.3 CONCLUSION

In the period April 1979 to September 1985, the South African foreign exchange market experienced significant reforms which encouraged the development of a free and competitive market in foreign exchange. This policy was promoted by the disengagement policy of the Reserve Bank and the relaxation of Exchange Controls, particularly over non-residents. The effect of the reforms was to improve economic efficiency as measured by the degree of economic freedom allowed to market participants, although such freedom may have increased exchange rate volatility. This is due to the increased freedom of market participants to allow their expectations to impact on the exchange rate.

The foreign debt standstill in September 1985 resulted in the effective reversal of the reform process, and the

imposition of further direct controls. This is reflected by the wide ambit of exchange control measures which at this time impact on the economic freedom of firms to transact in foreign exchange. Exchange Control affects the allocation of resources and if we accept that a free market will result in an efficient allocation of resources then Exchange Control by restricting market freedom has had a detrimental effect on economic efficiency.

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PART 2

CHAPTER 4**LITERATURE REVIEW : TESTS OF MARKET EFFICIENCY****OBJECTIVE**

This chapter presents methodologies employed in other studies to test the Efficient Market Hypothesis (EMH) in the context of the foreign exchange market. Tests of market efficiency are divided into tests on the existence of risk-free arbitrage profit opportunities, and the analysis of the time series behaviour of spot rates and forward rates to evaluate whether unusual returns exist for risky investments.

4.1 INTRODUCTION

An efficient market is a market where prices "fully reflect" the information set (Fama, 1970). The operational difficulties in this definition relate to the appropriate tests to be used to either accept or reject the Efficient Market Hypothesis in the context of the foreign exchange market.

This chapter represents firstly a literature review of methodologies used in various studies to test for Covered Interest Parity. This represents testing for essentially risk-free covered interest arbitrage opportunities.

Secondly, the chapter represents a literature review of methodologies used to test for the existence of unusual returns in the foreign exchange market, for investments involving varying degrees of risk. This is more difficult, due to estimating the relationship between risk and return and the definition of "equilibrium" returns. However, various studies have employed a number of tests on the time series behaviour of spot and forward exchange rates and the analysis of forecast errors to derive tentative conclusions

on the level of market efficiency in the foreign exchange market.

4.2 COVERED INTEREST PARITY

The Covered Interest Parity Theorem states that the forward exchange premium/discount should equal the interest differential between two currencies divided by one plus the local interest rate.

Therefore,

$$\frac{S-F}{S} = \frac{i-i^f}{1+i}$$

where; S = the spot exchange rate

F = the forward exchange rate

i = the domestic interest rate

i^f = the foreign interest rate

In the above equation, the exchange rates F and S are stated in terms of the indirect quotation system (i.e. exchange rates are expressed in terms of foreign currency). If a country uses the direct quotation system (i.e.

exchange rates are stated in terms of local currency) then the interest parity equation would be;

$$\frac{F-S}{S} = \frac{i-i^f}{1+i^f}$$

Aliber (1973) in his seminal paper on the subject analysed reasons why the quoted forward rate deviated from its predicted value as indicated by the interest parity equation. Money market assets in two countries differ in terms of currency of denomination and political jurisdiction.

Differences in currency of denomination result in exchange rate risk while differences in political jurisdiction result in political risk. Political risk refers to the possibility that the state authorities will apply exchange controls between the date a foreign investment is made and the date when repatriation of capital and income is due.

Forward exchange contracts enable investors to avoid exchange rate risk. Therefore, deviations from covered interest parity may reflect political risk and other factors, such as transaction costs and measurement error.

Aliber emphasized the role of differences in political risk in explaining deviations from covered interest parity.

Transaction costs refer to the costs of transacting in securities and foreign exchange. A covered interest arbitrage transaction will involve investors undertaking swap transactions, that is, the purchase (sale) of foreign currency in the spot market and the simultaneous sale (purchase) of foreign currency in the forward market.

The transaction costs in the foreign exchange market will constitute half the bid-ask spread in the spot market and half the bid-ask spread in the forward market. The purchase and sale of securities may involve brokerage and tax costs.

Measurement error refers to timing differences between recorded rates in two investment centres. Differences in the taxation of interest income and/or gains/losses from foreign exchange transactions, or the taxation treatment of the forward premium/discount may result in deviations from interest parity. Exchange controls may also limit the ability of arbitrageurs from taking advantage of deviations from interest parity.

It is possible to estimate the level of transaction costs and measurement error in terms of deviations from interest parity when similar securities quoted in different currencies fall under the same political jurisdiction.

Aliber does not refer to the inter-relationship of foreign exchange rate risk and political risk. Indeed, this is not referred to in the literature. The point is that a forward exchange contract constitutes a separate legally binding contract. Therefore, if the state authorities introduce measures to prevent the repatriation of capital and income, this will result in exchange rate risk, as investors are still obliged to meet the terms of the forward contract.

This means that the underlying forward transactions will need to be effected through offsetting transactions in the spot market. Therefore, the probability of political intervention may reflect the probability of foreign exchange rate risk if investors utilise forward exchange contracts to avoid foreign exchange exposure.

The probability of political intervention (i.e. the level of political risk) should be significantly less than the

probability of movements in the exchange rate and therefore undertaking a forward exchange contract will significantly reduce the level of foreign exchange exposure; however the level of political risk remains the common denominator, that is, exchange risk will not be eliminated but will be reduced to equal the level of political risk.

Prachowny's (1970) explanation that deviations from interest parity may be due to arbitrageurs borrowing at the prime rate in one country and investing at the Treasury bill rate in another country is incorrect as it ignores, the situations whereby arbitrageurs shift from lending in one country to lending in the other country, or whereby investors shift from borrowing in one country to borrowing in the other country.

However, switching from lending (borrowing) in one country to lending (borrowing) in another country would involve transaction costs at least to the extent that this would be reflected in the interest rate spread in the interbank market. Switching would also involve information costs in terms of search costs and costs in cancelling positions if funds constitute term deposits.

Branson (1969) estimated the transaction costs of arbitrage to be 0.18 percent between both New York and Montreal and New York and London. This estimate may be understated in terms the methodology employed as periods of "excessive speculative activity" were excluded.

Aliber (1973) used yields on U.S. dollar-denominated assets in London and on sterling-denominated assets issued in Paris to predict the forward sterling/U.S. dollar exchange rate. This was then compared to the quoted forward rate. Deviations from the forward rate were also calculated by employing the traditional method, that is, by using U.S. and U.K. treasury bill rates.

Aliber found that the mean deviation from interest parity (percent per annum) over the period January 1968 to June 1970 using the U.S. - U.K. treasury bill rates was 1.94 percent (S.D. = 1.93 percent) while the mean deviation from interest parity using the London U.S. dollar deposit - Paris sterling deposit rates was only 0.273 percent (S.D. = 0.40 percent).

The deviations from covered interest parity are much smaller when the London U.S. dollar and Paris sterling

deposit rates are used to predict the forward rate. Aliber concluded that a major explanatory factor for the difference between predicted and observed forward rates is due to using securities which are issued in different political jurisdictions. Interest parity deviations are primarily due to differences in political risk.

Aliber divides investors into two classes; speculators and arbitrageurs. Speculators specialise in carrying foreign exchange rate risk while arbitrageurs specialise in carrying political risk. However, as previously mentioned, Aliber ignores the fact that political risk may lead to exchange rate risk as a forward contract represents a separate legally binding contract whether or not the underlying transaction is affected by political intervention. A forward contract without the underlying transaction implies the investor is subject to foreign exchange rate risk.

Frenkel (1973) examined interest parity in terms of elasticities. Points off the interest parity line can be defined as equilibrium points if they are bounded by a neutral band around the traditional line from which covered interest arbitrage is not profitable. Boundaries around

the covered interest parity line is equivalent to assuming that the elasticities of demand and/or supply are less than infinite. Elasticities were found to be low, in most cases, elasticities were found to be below 10.

The covered interest parity equation should hold if the securities used are identical in all respects, such as maturity, risk, but except for the currency of denomination. Non-adherence to the comparability criterion, for example, due to differences in political risk referred to by Aliber, would be consistent with low elasticities.

Frenkel and Levich (1975) examined whether deviations from covered interest parity implied unexploited profit opportunities. Transaction costs would result in a neutral band around the interest parity line. Observations within this band represent equilibrium points of no possible profitable arbitrage.

Transaction costs consist of two elements; the costs of transacting in the foreign exchange market and the costs of transacting in the securities markets. Frenkel and Levich estimate the level of transaction costs in the foreign

exchange market by using the technique of triangular arbitrage.

Triangular arbitrage would keep cross-exchange rates consistent, therefore if transaction costs equal zero, then, for example, the following would hold true:

$$(\$ / FF)_t = (\$ / DM)_t (DM / FF)_t$$

Transaction costs are measured by the discrepancy between the two sides of the equation. Frenkel and Levich's estimates of transaction costs represent the percentage deviation which bounds 95 percent of the deviations from triangular arbitrage. The percentage cost of transactions in the foreign exchange market (spot and 90 day forward) amounted to a maximum of 0.131 percent.

Frenkel and Levich point out that estimates of transaction costs could also be based on the bid-ask spreads in the foreign exchange market.

Transaction costs in the securities market consist of two elements; the bid-ask spread and the brokerage fee. Demsetz (1968) estimated total costs in transacting in

securities to be 2.5 times the bid-ask spread in the foreign exchange market. Frenkel and Levich applied this estimate to U.S., U.K. and Canadian Treasury Bills. The total costs in a 90-day covered interest arbitrage transaction was estimated to be 0.15 percent. This is close to Branson's (1969) estimate of 0.18 percent.

Frenkel and Levich use interest rates and forward premiums for specific periods and point to the arithmetical problem of using annualised data as this would result in illusory profit opportunities. Estimates of transaction costs are also period specific, therefore data which is quoted in annualised terms have to be converted to their 90 day equivalents.

Using their estimates for the costs of transacting in the foreign exchange markets and securities markets, Frenkel and Levich computed a neutral band around the interest parity line.

Treasury Bill rates in the U.S. and the U.K. (termed the traditional pair) and Euro-sterling deposit rates in Paris and Euro-dollar deposit rates in London (termed the external pair) were used to measure the percentage of

observations bounded by the neutral band around the interest parity line.

Frenkel and Levich found that for the traditional pair, transaction costs accounted for about 85 percent of the apparent profit opportunities as indicated by the deviations from interest parity.

However, for the external pair of securities, more than 99 percent of all deviations were accounted for by transaction costs. It was found that the elasticities become very high if transaction costs are taken into account. This is consistent with the high level of competitiveness in these markets.

The observations which are not bounded by the neutral band around the interest parity line could be due to differences in risk, taxation, elasticities which are less than infinite and a time lag between noting an arbitrage opportunity and undertaking an arbitrage transaction.

Levich (1979[b]) used Clendenning's (1970) estimate of the level of transaction costs of 0.25 percent to calculate

the percentage of deviations from interest parity that would result in profitable arbitrage transactions.

Levich examined assets with a 3 month maturity and took weekly observations for the period, 1967-1975. Between external deposits quoted in the U.S. dollar and deposits quoted in the major currencies of the Canadian dollar, sterling, deutschemarks and guilders, over 93 percent of deviations were within the transaction cost band of 0.25 percent.

Using Treasury Bill rates issued in the above currencies, the percentage of deviations which lay within 0.25 percent of the interest parity line ranged from 72 percent for Canada, to 44 percent for Germany. Therefore interest parity did not hold to the same extent when applying the same tests to securities issued in different legal and political jurisdictions. Levich's results are depicted in Table 4.1.

**TABLE 4.1 PERCENTAGE OF DEVIATIONS FROM INTEREST PARITY
WITHIN $\pm 0.25\%$ BOUNDARIES**

Country	Treasury Bills	External Deposits
-----	-----	-----
Canada	72	93
United Kingdom	56	97
Belgium	37	78
France	30	83
Germany	44	99
Italy	11	66
Netherlands	56	97
Switzerland	27	79

All countries but particularly Switzerland, Italy, France and Belgium show significant differences in terms of adherence to covered interest parity when using Treasury Bill rates as compared to using external deposit rates to test the interest parity theorem. Although, Levich omits to emphasise the possible factors responsible for the differences, Aliber's study emphasised differences in

political risk. Capital controls should also inhibit the flow of funds to take advantage of deviations from interest parity.

Frenkel and Levich (1977) analysed the extent that the efficiency of covered interest arbitrage has been affected by different exchange rate systems. Three periods were examined; 1962-67, the tranquil peg; 1968-69, the turbulent peg; and 1973-75, the managed float. It was found to be more useful to classify periods by the level of turbulence rather than by the legal and institutional framework of the exchange rate system. Transaction costs were measured by employing the method of triangular arbitrage.

Frenkel and Levich divided the observations into specific periods by examining the ratio of the forward to the spot exchange rate. Under a pegged exchange rate system, a forward rate which was outside the support limits could reflect expectations that the authorities would be unable to maintain the peg. On the basis of the relationship of the forward to the spot rate, Frenkel and Levich selected the three periods; 1962-67, 1968-69 and 1973-75 as three homogeneous periods.

The period 1968-69 reflected a period of turbulence in foreign exchange markets. This period was preceded by the devaluation of sterling in November 1967. The managed float period reflected a period of volatility in exchange rates. Bid-ask spreads in the foreign exchange market tend to be wider during periods of uncertainty. Fieleke (1975) found that in the managed float period there was a positive relationship between the bid-ask spread and proxies measuring levels of uncertainty.

Frenkel and Levich found that during the tranquil peg period (i.e. 1962-67), triangular arbitrage between the U.S. dollar and sterling using the deutschemark as the intermediate currency indicated the total percentage cost (spot and forward) of transacting in foreign exchange to be equal to 0.127 percent. This estimate increased to 0.262 percent for the turbulent peg period (i.e. 1968-69) and then showed a further dramatic increase to 1.03 percent for the managed float period.

Frenkel and Levich employed Demsetz's (1968) estimate which indicated the total costs of transacting in securities to be 2.5 times the bid-ask spread in the foreign exchange market. The cost of transacting in U.S. treasury bills

increased from the tranquil peg period through to the managed float period. The modal values of transaction costs for 90-day securities in the Euro-dollar and Euro-sterling markets was 0.038 and 0.117 percent respectively.

During the tranquil peg and the managed float periods, transaction costs accounted for a similar proportion of deviations from interest parity. Transaction costs accounted for over 80 percent of deviations for the traditional pair of securities (i.e. Treasury Bills) and over 99 percent for the external pair (i.e. Euro-currency deposits). However, during the 1968-69 period the costs of transactions accounted for a much smaller proportion of the deviations from covered interest parity in respect to the traditional pair of securities.

For the external pair of securities, most observations were bounded by the neutral band around the interest parity line. This period reflected financial uncertainty and the results for the traditional pair may reflect a lack of comparability which is a necessary condition for the interest parity equation to hold. Lack of comparability may be due to the assets being issued in two different political jurisdictions.

To test for unexploited profit opportunities, Frenkel and Levich devised a simple trading rule of using information at time t and acting upon this information at time $t+1$. During the tranquil peg and managed float periods the mean percentage profits are reduced to approximately 0.04 and 0.01 percent respectively. During the turbulent peg period, the trading rule results in statistically significant profits. However, the securities may reflect incomparability.

McCormick (1979) adopted Frenkel and Levich's methodology and applied it to data of higher quality. The use of triangular arbitrage to measure the total cost of transacting in the foreign exchange market requires that exchange rates be observed almost simultaneously.

The data in Frenkel and Levich's study do not meet the simultaneity criterion, as the New York rates used represent the closing mid-rates (about 4 pm New York time) whereas the deutschemark-sterling rates in London represent the mid points of the Montagu bank's lowest bid and highest ask rates during the London trading day.

During the 1973-75 period the time difference between rates quoted in New York and London widened to 4-13 hours. Therefore the recorded rates did not represent the rates that were available simultaneously in the two centres. As rates may move significantly within a timespan of a few hours, this represented a serious limitation in the study by Frenkel and Levich.

McCormick used daily Reuters' quotations with rates quoted within one hour of each centre. The values of the discrepancies from triangular arbitrage that bounded 95 percent of these discrepancies reflected a transaction cost percentage of 0.182 percent for the U.S. dollar, sterling and deutschemark rates, for the period April 1976 to October 1976. Using the Montagu-IFS data source employed by Frenkel and Levich for the same period, McCormick calculated the percentage cost of transactions to be 0.664 percent.

The estimate of transaction costs using simultaneous data is less than 30 percent of the level of transaction costs as indicated by utilising Frenkel and Levich's data source. The lagging of the Reuters data for one day resulted in a material increase in the "transaction costs" estimate.

Therefore the time difference between exchange rate observations may have a material effect on the estimates of transaction costs (based on Frenkel and Levich's triangular arbitrage methodology).

McCormick calculated the percentage of deviations from interest parity that could be explained by different estimates of transaction costs. The estimate of transaction costs using the Montagu-IFS data explain 96 percent of the deviations from interest parity for arbitrage between U.S. and U.K. treasury bills. However, using the Reuters' foreign exchange data, only 58 percent and 38 percent of the deviations from interest parity can be explained by transaction costs for the U.S. dollar, sterling and the deutschemark case and the U.S. dollar, sterling and the Canadian dollar case respectively.

In the case of arbitrage between the Euro-dollar and Euro-sterling markets, the Reuters data does not make any difference to the results of Frenkel and Levich as 100 percent of deviations from interest parity are explained by transaction costs.

McCormick indicates that the level of deviations not explained by transaction costs is consistent with the stringent capital controls imposed by the U.K. authorities during that period.

This point is relevant in the South African situation and will be examined later in the study. McCormick's results add further credence to the conclusions reached by Aliber (1973) relating to the non-comparability of securities issued in different countries due to differences in levels of political risk.

Levich (1979[b]) states that risk-free profitable arbitrage opportunities are quickly eliminated due to arbitrage activities. Levich reintroduces the two most commonly used methods for testing the covered interest parity theorem. The first method is based on an analysis of the deviations from covered interest parity and may be stated as follows:

$$d = \frac{F-S}{S} - \frac{i-i^f}{1+i^f}$$

Interest parity is assumed to hold if the hypothesis of $d = 0$ cannot be rejected.

The second method is based on applying the following regression equation;

$$\frac{F-S}{S} = a + b \frac{i-i^f}{1+i^f}$$

Interest parity is assumed to apply if the hypothesis that $a = 0$ and $b = 1$, cannot be rejected.

The above methods are not sufficient to test the validity of the covered interest parity theorem. This is because both methods test the average relationship between the interest differential and the quoted forward premium. Therefore it is important to examine the deviation from covered interest parity for every single period and compare the deviations to estimates of transaction costs. An analysis of the percentage of times that covered interest arbitrage will not result in profits in excess of related transaction costs allows us to make valid conclusions on the level of market efficiency.

Levich restates the findings from previous studies that covered interest parity holds in unregulated markets such as the Euro-currency markets but does not readily hold for securities issued in different political jurisdictions.

Dooley and Isard (1980) examined the extent that political risk and capital controls accounted for the deviations from interest parity. Aliber's (1973, p.1453) definition of political risk is used as the starting point of their study; political risk is defined as,

"the probability that the authority of the state will be interposed between investors in one country and investment opportunities in other countries."

Political risk refers to the probability of future capital controls rather than existing capital controls. Dooley and Isard examined the differential between Euro-mark deposit interest rates quoted in Zurich and interbank deutschemark denominated loan rates quoted in Frankfurt for 3 month maturities for the period January 1970 to December 1973. In this period Germany placed a number of exchange controls

on non-residents in an effort to stem large capital inflows.

The interest differential between the Euro-mark rate and the domestic interbank loan rate increased from close to zero at the beginning of 1970 to reach a difference, at an annual rate, of 10 percent in April 1973. The interest differential was positive regarding domestic rates, that is, local interbank loan rates exceeded Euro-mark deposit rates during that period. The interest differential includes transaction costs as it represents the difference between a loan rate and a deposit rate.

Dooley and Isard present two arguments to explain the interest differential between Euro-bank deutschemark-denominated deposit accounts, and German domestic interest rates. The sale of marks in the spot market by the German Bundesbank resulted a lower spot value of the mark; lower than the value that would have prevailed in a free market. At the same time there were speculative demands for forward marks. The combination of these factors resulted in profitable covered interest arbitrage opportunities for investors moving capital into mark-denominated German bank deposits. Dooley and Isard state that arbitrageurs would

purchase marks spot from the Bundesbank, invest the marks in German bank deposits and sell the marks forward to private speculators.. However, as non-residents increased their claims on German banks and government through such arbitrage transactions, investors became increasingly reluctant to increase their positions due to the concomitant political risks specific to non-resident claims on the German private and public sectors.

Non-residents could diversify out this political risk by moving funds into Euro-bank mark-denominated deposit accounts. However, this would mean that Euro-banks would have to carry uncovered mark liabilities subject to exchange risk or carry the political risk of investing in mark-denominated securities in Germany. Therefore, Euro-banks discouraged investors from investing in Euro-mark deposits by offering lower yields. Dooley and Isard (1980, p.372) conclude their first argument by stating that;

"the difference between Euro-mark rates and the interest rates available on claims against German residents can be attributed to the reluctance of non-resident arbitrageurs, including Euro-banks,

to acquire a larger stock of claims on German residents."

The second argument employed to explain deviations from covered interest parity relates to the effects of existing capital controls. In this case deviations from covered interest parity are attributed to the effective tax that existing capital controls placed on interest earnings due to non-residents in Germany.

The types of controls that the Bundesbank placed on non-resident investments in Germany included the following:

- * A special bank reserve ratio was required on nonresident deposits with German Banks.

- * Bundesbank authorisations were required for interest payments on nonresident bank deposits.

- * A cash deposit of 40 percent and later 50 percent was required on new nonresident deposit accounts. This deposit was held with the Bundesbank and did not earn any interest.

* Prior Bundesbank authorisation was required for the purchase of fixed-interest securities and the purchase of shares in local companies.

In order to separate the effects of existing capital controls from prospective capital controls, Dooley and Isard (1980, p.371) base their model on the assumption that;

"the prospect of future capital controls depends essentially on the gross supplies of debt outstanding against different governments and the distribution of world wealth among residents of different political jurisdictions."

The results of the study indicate that most of the difference between the Euro-mark interest rate and the local interest rate was due to the tax placed on nonresident earnings by the capital controls imposed by the Bundesbank. When the differential reached 10 percent between February and October 1973, Dooley and Isard estimated that the tax due to existing controls accounted for 6 percent of the interest differential and another 2

percent was due to the political risk involved, while 2 percent of the differential remained unexplained.

The major limitation to this study, as expressed by Dooley and Isard (1980, p.302), is that the tax imposed by existing capital controls,

"cannot be computed from microeconomic principles in the German case, so we are forced to be somewhat arbitrary in modeling and estimating it."

The study also relied on the assumption that the probability of future capital controls remained constant in the period under study. The probability of future capital controls were assumed to be independent of the level of existing controls.

Barr and Kantor (1984) examined interest parity and money supply effects in the context of the South African foreign exchange market. The authors firstly present the interest parity relationship under free exchange rate markets and state that any deviation from covered interest parity would present opportunities for profitable covered interest

arbitrage transactions. If the central bank manages the spot and forward exchange markets then Barr and Kantor (1984, p.45) state that;

"differences between local and foreign interest rates may not equal the exchange rate premium/discount as determined by the central bank and this quoted premium/discount may imply a future exchange rate which differs considerably from what the market believes the exchange rate will be at the end of the relevant time period."

The study presents an analysis of the cost of local versus foreign finance by comparing local interest rates to foreign interest rates including the cost of forward cover. Expectations are introduced into their model, so that the expected future spot rate can be employed to determine the cost of uncovered offshore finance. However, the latter financing option is not directly comparable to the local and covered offshore finance options due to differences in risk.

The total cost of uncovered offshore finance may be variable due to exchange rate movements. The huge foreign

exchange losses incurred by companies in South Africa and other countries such as Australia points to the high level of exchange risk involved in taking out uncovered offshore finance.

Therefore, the fact that the cost of uncovered finance is less than the cost of local finance would not necessarily lead to firms taking out uncovered finance.

Barr and Kantor (1984, p.47) present the situation where the central bank manages the forward rate to influence capital flows;

"the central bank may adjust its quoted rate and provide forward currency at artificially low costs in order to increase the volume of capital account inflows and thus its foreign exchange reserves."

The study also examines the effects that capital flows will have on the money supply. If the central bank sets the forward rate to encourage borrowing from foreign sources then the incentive will be maintained for as long as the central bank prevents an increase in the money supply and a

fall in local interest rates and prevents an appreciation in the spot rate.

A model is employed to measure expectations of the future spot rate and compare the cost of local finance to the cost of covered offshore finance and uncovered offshore finance. The computation and comparison of the cost of each financing option is carried out for the period January 1980 to April 1983. The costs of finance are based on the New York three monthly bankers' acceptance rates and the local three monthly bankers' acceptance rates. All rates used were annualised rates.

The expectation of the future spot rate was based on the correlation of the spot rate to the U.S. dollar gold price over a moving period of twelve months. Barr and Kantor present the costs to local firms of each financing option for the period under study. An adjustment was made for the risk involved in the uncovered offshore finance option.

Barr and Kantor conclude that South African borrowers would have benefited by undertaking uncovered offshore finance from August 1982 as the forward rate predicted a decline in the future spot rate. This deviated from the expected

future spot rate which was based on the fact that a significant increase in the gold price had taken place. The decline in the gold price in 1983 resulted in the cost of uncovered finance then becoming higher than the cost of local finance.

The study points to significant deviations from interest parity as there are material differences between the cost of local finance and the cost of covered offshore finance.

Barr and Kantor's study is however subject to certain limitations. Firstly, the data was not transformed by dividing by four to reflect the estimated rates facing traders for each specific period. Barr and Kantor use the annualised three monthly data to determine deviations from interest parity. Frenkel and Levich (1975, p.331) state;

"Since there is no presumption that the forward premium on a yearly contract for foreign exchange should be four times the forward premium on a 90 day contract, it is clear that annualizing the premiums might introduce noise to the data. Similar noise might be introduced by the annualised interest rates series since there is

no presumption that the interest differential on 1-year securities should be four times the corresponding differential on 90-day securities...the method of annualization multiplies all deviations from the interest parity line by about four and thereby creates illusory profit margins."

Secondly, the study does not take into account the effect that transaction costs may have on their conclusions in respect to switching from one financing source to another. Thirdly, Barr and Kantor use the approximation form of the covered interest parity equation, i.e. $i - i^f = (F - S)/S$ rather than precise form of $(i - i^f)/(1 + i^f) = (F - S)/S$. As deviations from interest parity represent relatively risk-free profit opportunities, small deviations may lead to large capital flows. Therefore, it may be of importance to employ the precise form of the interest parity equation to measure deviations rather than its approximation form.

Fourthly, Barr and Kantor employ the covered interest parity equation based on a direct quotation system but use data quoted on an indirect quotation system. Further, the factors of political risk and capital controls were ignored

in explaining deviations from interest parity when such factors are obviously important to the South African situation.

Isard (1987) states that deviations from covered interest parity reflect transaction costs, the effects of capital controls and/or the fact that the foreign and local assets are not directly comparable. Isard (1987, p.7-8) further states;

"deviations from CIP (covered interest parity) are usually negligible when Eurocurrency data are used as measures of interest rates. By the same token, however, observed deviations from CIP can play a central role in those empirical studies that emphasize that claims on the residents of different countries may not be comparable because of capital controls or different political or credit risks."

Taylor (1987) tested for covered interest parity by using high-frequency contemporaneously sampled data from the London foreign exchange market. Taylor (1987, p.429)

referred to a number of studies which had reported deviations from covered interest parity and argued that;

"the results of such studies almost certainly reflect data imperfections rather than market inefficiencies."

Taylor states that it is important that the data used to test interest parity should be contemporaneously sampled and reflect the rates that a trader faced.

Taylor states (1987, p.431) that various studies have reported deviations from interest parity and that these studies;

"have attempted to rationalize these departures in terms of political risk (Aliber, 1973); transaction costs (Branson, 1969; Frenkel and Levich, 1975, 1977); capital market imperfections (Prachowny, 1970; Frenkel, 1973)."

Taylor states that the majority of these empirical studies on interest parity made use of published data which were

not contemporaneously sampled. For example, Taylor (1987, p.431) states that;

"the exchange rate data used by Frenkel and Levich (1977) was recorded several hours later than the interest rate data."

Taylor tested data recorded in the London foreign exchange market on 11, 12 and 13 November 1985. Taylor made use of a direct telephone link with brokers and recorded rates every 10 minutes for the spot U.S. dollar/sterling and U.S. dollar/deutschemark exchange rates; the forward exchange U.S. dollar/deutschemark and U.S. dollar/sterling rates for various maturities and Euro-deposit interest rates for sterling, deutschemarks and U.S. dollars for various maturities.

Taylor found that no opportunities for covered interest arbitrage existed at any time over the three days for the U.S. dollar/sterling data and for triangular arbitrage between sterling and the deutschemark while the U.S. dollar/deutschemark data indicated just one profitable arbitrage opportunity over three days but this was insufficient to cover the 0.02 percent brokerage fee.

Although Taylor's study comes close to reflecting the actual data facing traders, the limited observation period as indicated (and recognised) by Taylor reflected a limitation of the study. The study reflected a further significant problem in methodology; Taylor indicated that deviations from interest parity reported in other studies reflected data imperfections due to the use of published data which were not sampled simultaneously. Taylor states that this led to writers such as Aliber and Frenkel and Levich to "rationalise" these departures from interest parity.

Taylor's conclusions are mis-directed. The truth is that most studies [for example, see Aliber (1973) and McCormick (1979)] recognise that covered interest parity is valid for unregulated markets such as the Euro-currency markets while these same studies have reported deviations for regulated markets. It is the deviations reported by these studies in the regulated markets that have led to explanations ("rationalisations") such as differences in political risk and the existence of capital controls.

Taylor states that the deviations reported in these studies represent data imperfections, yet Taylor tests for covered interest parity in the Euro-currency markets rather than testing for covered interest parity in the regulated markets. In effect, the study draws conclusions on regulated markets by using the results of tests on unregulated markets. Taylor's study does not validate his conclusion and does not explain reported deviations in regulated markets. Taylor's study merely reinforces the results of previous studies which reported the validity of the interest parity theorem in unregulated markets.

4.3 TESTS ON THE EFFICIENCY OF THE SPOT AND FORWARD MARKETS

Fama (1970) defined an efficient market as being one where prices "fully reflect" available information.

Frenkel (1976) stated that the current exchange rate reflects future expectations and this accounts for the material volatility in exchange rates. Frenkel states that if the foreign exchange market is efficient then the current exchange rate should reflect the available information set.

Frenkel examined the efficiency of the foreign exchange market during the German hyper-inflation period. This reflected a period of extreme monetary disturbance. To test for market efficiency, Frenkel regressed the logarithm of the current spot rate on the logarithm of the one-month forward rate reported in the previous month;

$$\log S_t = a + b \log F_{t-1} + u_t$$

If the market is efficient then the constant term should not be significantly different from zero and the slope

coefficient should not be significantly different from unity. The residual term should be serially uncorrelated.

Frenkel found that the constant term was not significantly different from zero while the beta coefficient was slightly above unity. The coefficient of determination (R^2) was 98 percent. The Durban-Watson statistic of 1.90 indicated the absence of serial correlation in the residuals, which is indicative of market efficiency. Frenkel indicated that a beta coefficient slightly higher than unity may reflect transaction costs.

Frenkel examined the time series plot of the logarithm of the spot rate and forward rate and found that the forward rate will "lie below" the spot rate when there is an appreciation in the spot rate and will "lie above" the current spot rate, during a period of depreciation in the spot rate.

Frenkel examined the information content of the forward rate at time $t-1$. In an efficient market, F_{t-1} should reflect all information at time $t-1$, relating to the expected future spot rate, S_t . Information available at time $t-1$ would include information at time $t-2$, which

should be included in the forward rate, F_{t-2} . As F_{t-1} includes the information reflected in F_{t-2} , the addition of F_{t-2} to the OLS equation should not affect the coefficient of determination while the coefficient of F_{t-2} should not be significantly different from zero. The result of this test supported the hypothesis of an efficient foreign exchange market.

Frenkel also tested for purchasing power parity in the German hyper-inflation period and observed a high correlation between prices and the exchange rate. The study concluded that purchasing parity is valid during periods of extreme monetary disturbance.

A limitation of his study is that the testing of the hyper-inflation period does not help in explaining the effects of real disturbances on the exchange rate.

Giddy (1983) states that an efficient market is one in which exchange rates are determined by expectations, and rates react immediately to new information so that opportunities for profitable speculation are quickly eliminated. If traders do not have privileged access to "news", then traders will not consistently earn a return

that is greater than a buy-and-hold policy. Giddy states that public information will not be useful in predicting future exchange rates because this information is already discounted in the current exchange rate.

Giddy (1983, p. 70) states;

"Under current floating rate conditions, exchange rates do appear to fluctuate in a random fashion; and according to recent theory and empirical research, the foreign exchange market fulfills the conditions of an efficient market. This means that exchange rate forecasting models cannot consistently beat the market forecast".

Giddy presents the unbiased forward rate theory, which states that the forward rate equals the market's expected future spot rate. If the forward rate did not equal the future spot rate, then traders could earn unusual returns by purchasing the foreign currency forward if the forward rate was quoted below the expected future spot rate and sell the foreign currency forward if the forward rate was quoted above the expected future spot rate.

Giddy states that forward rates, relative interest rates and relative inflation rates will often not be reliable predictors of future spot rates. This is due to the fact that current exchange rates reflect current information. New information will impact on the exchange rate making past predictions unreliable.

Bilson (1978) states that the current spot rate depends on expectations about future exogenous variables. Any new information that affects expectations about the exogenous variables, such as money supply growth, will be immediately reflected in the spot rate. Bilson refers to the magnification effect which relates to the situation where the percentage change in the exchange rate exceeds the percentage change in the exogenous variable. A small change in an exogenous variable, such as money supply growth, may lead to a large alteration in the spot rate if general expectations are that the change in money supply growth is permanent.

Therefore, it is not the current change in the exogenous variable that matters, but rather the effect that such a change has on expectations.

Levich (1979[b]) states that tests for market efficiency involve examining the availability of unusual returns. Investment opportunities are divided into risk-free and risky investments. Although the empirical evidence mostly supports the efficient market hypothesis to the extent that risk-free profitable covered interest arbitrage opportunities are quickly eliminated, the research evidence on risky investments has produced less substantive results.

Market efficiency requires that unusual profit opportunities in risky investments are quickly eliminated. Levich (1979[b], p.16) states:

"...it is difficult to test if investors efficiently set the actual spot exchange rate equal to its equilibrium value unless there is some agreement on what the equilibrium value is".

Levich presents two methods often used to test for market efficiency in the spot market.

The first method examines whether changes in the spot exchange rate are serially correlated. However, if the expected equilibrium return changes significantly over

time, then market efficiency would require actual rates to wonder randomly around the expected return, and over time serial correlation in this case would be consistent with market efficiency.

Therefore, the test for serial correlation represents a test of a joint hypothesis; that the market is efficient and the equilibrium return is constant.

The second method for testing for market efficiency in the spot market, is to test the profitability of using a filter trading rule. A filter trading rule would consist of buying a foreign currency denominated interest bearing asset when the foreign currency rises by a stated percentage and selling the foreign currency denominated interest bearing asset for a local currency denominated interest bearing asset when the foreign currency falls by a stated percentage.

If the market is efficient, then the expected profit from applying a filter trading rule should be zero.

Cornell and Dietrich (1978) test for serial correlation and for profits from using mechanical trading rules, by

analysing daily rates for six currencies for the period March 1973 to September 1975. Cornell and Dietrich found that the changes in daily exchange rates were not subject to serial correlation.

Cornell and Dietrich compare the profitability of a filter trading rule to a buy-and-hold U.S. dollars policy. An adjustment is made for transaction costs and for interest received or paid while maintaining a foreign currency position.

Cornell and Dietrich found that a filter trading rule for deutschemarks, Dutch guilders and Swiss francs resulted in significantly greater profits than the buy-and-hold option.

Levich (1979[b]) states that the limitations of this type of study is that it is uncertain if, ex ante, the size of the filter that optimises profits can be determined. Even if a filter trading rule results in consistent profits over a period, invariably, losses are reported within specific time periods. This means that this trading rule may include a risk element which accounts for the positive return.

Levich states that as the foreign currency rates are only valid for a specific volume of contracts, profits may be quickly eliminated after a certain value is traded.

Another factor, ignored by Levich and Cornell and Dietrich is that the German and Swiss authorities applied capital controls during part of the sample period to limit capital inflows. For example, the non-interest bearing deposit required by the German authorities on non-resident deposits reduced the yield to non-residents of deutschemark denominated assets which is not reflected in the local rates used by Cornell and Dietrich.

These controls flowed through to the Euro-currency rates as Euro-banks, to cover positions, would need to increase their claims on German residents.

Euro-banks therefore offered lower rates due to the effective tax that capital controls placed on interest earnings on deutschemark denominated deposits.

Levich (1979[b]) restates the techniques used to test for market efficiency in the forward market. The following regression equation is tested:

$$\frac{S_{t+n}}{S_t} = a + b \frac{F_{t,n}}{S_t} + e_t$$

If the constant term, a , is not significantly different from zero, and the beta coefficient, b , is not significantly different from unity, then we can conclude that the forward rate is an unbiased predictor of the future spot rate. However, if changes in the spot rate are random, then the forward premiums/discounts will explain only a small percentage of changes in the spot rate. This means that although, the equation may result in a low R^2 , the forward rate may still be an unbiased predictor of the future spot rate.

The study restates another technique used to measure market efficiency, which represents the analysis of the forecast error;

$$e_{t,n} = S_{t+n} - F_{t,n}$$

Levich (1979[a]) and Giddy and Dufey (1975) found that over long periods for most of the currencies tested, the mean

errors do not differ significantly from zero. In addition, these forecast errors are serially uncorrelated. Therefore, the analysis of trends in past forecast errors will not result in superior forecasting results.

Results consistent with the unbiasedness of the forward rate as a predictor of the future spot rate, have been interpreted as an indication of market efficiency. However, there are theories which are consistent with the existence of a forward risk premium. Grauer, Litzenberger, and Stehle (1976) and Cornell (1977) tested for the existence of a forward risk premium. This is examined in more detail later in the chapter.

Market efficiency requires that the forward rate should represent the best available forecast of the future spot rate. Levich (1979[a]) concluded that time series forecasts and composite forecasts did not outperform the forward rate.

One test of semi-strong market efficiency consists of comparing the forward rate, to the foreign exchange forecasts prepared by foreign exchange advisory services. Levich (1979[b]) analysed the forecasts for the Predex

Corporation for the period April 1975-October 1977. The results were mixed. For the deutschemark and lira, the Predex forecasts were significantly better than the forward rate. However, for the Canadian dollar and the yen, the Predex forecasts were significantly worse than the forward rate.

In the case of sterling and the French franc, the forecasts were not significantly different from the forward rate. Levich refers to a study by King (1978) who found that the average professional forecast error was smaller than the average forward rate forecast error; however, only for the deutschemark was this difference significant.

Levich (1980) analysed the accuracy of forecasts prepared by advisory services. On the basis of mean squared errors the study found that most forecasts were not as accurate as the forward rate, but that for several advisory services, "the record of correct forecasts and percent of perfect information profits are too good to be explained by chance" (Levich, 1980 : p.122)

Levich (1979[c]) could not reject the hypothesis that the forward rate is an unbiased forecast of the future spot

rate. It was also found that the results reflected a low R^2 and, therefore the predictive power of the model was not significant.

Cornell (1977) examined the relationship between forward exchange rates and subsequent spot rates. Cornell tested for the existence of a forward risk premium. The concept of market efficiency and the unbiasedness of forward rates as predictors of future spot rates are separated.

In a market that is semi-strong efficient, a trader would be unable to use public information to earn unusual risk-adjusted profits. This has been interpreted that market efficiency requires the forward rate to be an unbiased predictor of the spot rate, otherwise traders could use the bias to earn profits by undertaking speculative positions in the spot and forward market.

However, the unbiasedness equals market efficiency argument ignores the risk undertaken by traders who take a position in foreign exchange. If this risk represents a systematic risk, then the forward rate should exhibit bias, as this represents the only way that a risk premium can be paid. Grauer, Litzenberger and Stehle (1976) defined this

systematic risk as the dependence between the future spot price of foreign exchange and real gross world product.

Cornell (1977) tested for the existence of a risk premium by examining monthly spot and one-month forward rates for several currencies for the period April 1973-January 1977.

The study could not find any evidence to support the existence of a risk premium. If the risk premium is zero then Cornell states that in an efficient market, the standard deviation of the forecast errors (i.e. the difference between the forward rate and subsequently observed spot rate $[X_t]$), should not be greater than the standard deviation of the forecast errors from any other model.

Cornell (1977) compares the forward rate forecast errors (i.e. $F_{t-1} - X_t$) to the forecast errors of employing the martingale model, which is;

$$E_{t-1}(X_t) = X_{t-1}$$

The martingale model outperforms the forward rate for five of the seven currencies tested. Cornell estimated the following two additional models;

$$X_t - X_{t-1} = a_0 + a_1[X_{t-1} - X_{t-2}]$$

$$X_t - X_{t-1} = a_0 + a_1[X_{t-1} - X_{t-2}] + a_2[X_{t-3} - X_{t-4}]$$

These models improved upon the martingale model, in that the standard error was less than the standard deviation of the forecast errors for sterling, the U.S. dollar and the yen. The study found that although the best autoregressive model outperformed the forward rate for six of the seven currencies, the differences were too immaterial to draw firm conclusions about the absence of market efficiency.

The following model was also tested;

$$F_{t-1} - X_t = a_0 + a_1[X_{t-1} - X_{t-2}]$$

Market efficiency would require that the forward premium is uncorrelated with past spot rates and therefore the coefficient a_1 should not be significantly different from

zero. Cornell found that a_1 was not significantly different from zero for six of the seven currencies tested.

Mussa (1979) analysed the two theories of foreign exchange rate determination, that is, the flow market model and the asset market model in the context of the empirical regularities found to exist in the foreign market. The asset market theory was found to be appropriate in explaining the behaviour of exchange rates.

Mussa (1979, p.10) goes on to state that if exchange rates are not fixed or controlled by intervention by the central bank, then

"the natural logarithm of the spot exchange rate follows approximately a random walk."

The error term is serially uncorrelated. The study goes on to state that the expected change in the spot exchange rate between two successive periods is minor relative to the period to period variability of the spot rate.

The study states that there is evidence of a small degree of serial correlation in exchange rate changes. Mussa

(1979) observes that there appear to be periods of relative calm which are followed by periods of turbulence, with the exchange rate perhaps moving in one direction. The study concludes that the exchange rate could be influenced by policies undertaken by the central bank.

If the central bank is able or is seen to be able to hold or to maintain an exchange rate, then there will be little reason or motivation for traders to speculate against the central bank. However, when evidence reaches the market that the central bank is no longer able to maintain the exchange rate, then speculation would ensure a dramatic movement in the spot rate. This would be expected to result in some serial correlation in exchange rate movements.

Another empirical regularity in the foreign exchange market is that the change in the forward rate is always very close to the change in the contemporaneous spot rate. Mussa (1979) plotted the spot rate and the contemporaneous forward rate for sterling on a monthly basis from 1921 through to 1924, and plotted the U.S. dollar/sterling spot rate and the contemporaneous forward rate on a monthly basis for the period January 1973 - September 1976.

In addition, the study plots the deutschemark/U.S. dollar spot rate and contemporaneous forward rate on a monthly basis for the period January 1973 - September 1976. In all cases it was found from the observation of the time series plots that the spot rate and the contemporaneous forward rate moved very closely with one another. The difference between these two rates in the plots reflected the forward premium/discount.

In examining the relationship between the forward rate and the corresponding future spot rate, it was found that the forward exchange rate was an unbiased predictor of the future spot exchange rate. However, the forward rate was not a good predictor of the future spot exchange rate.

Mussa (1979) plotted the spot rate and the corresponding forward rate for sterling on a monthly basis for the period January 1973 - June 1976. The study concluded that the forward rate did not appear to be successful in predicting changes in the spot rate.

Mussa found that the forward rate was marginally superior to the spot rate as a predictor of the future spot rate.

This is due to the fact that over the sample period, sterling was at a consistent forward discount and in that period sterling did in fact depreciate.

The percentage change in the spot rate for the deutschemark/U.S. dollar exchange rate was plotted against the expected change in the spot rate as reflected by the forward premium on the U.S. dollar. It was found that the forward premium was not able to predict the change in the spot rate. The variation in the spot rate was material in relation to the variation in the forward premium.

The forward rate may deviate from the expected future spot rate due to the existence of a risk premium. Mussa states that this risk premium may be material during periods of currency crises and that a large forward discount on a currency expected to depreciate or expected to experience volatility in the exchange rate, could reflect market participants avoiding exposure in that currency.

Mussa (1979) analyses the purchasing parity theory and states that in the long run during periods of monetary disturbance, the movement in exchange rates should reflect

the differential in inflation rates. However, Mussa states (1979, p.23);

"month to month changes in exchange rates are not well correlated with month to month changes in relative purchasing power parities."

The study also states that countries with high nominal interest rates would tend to have depreciating currencies and countries with material trade deficits also tend to have depreciating currencies. Further, countries with rapidly expanding money supplies tend to have depreciating exchange rates.

Frenkel (1981) analysed the efficiency of the foreign exchange market by testing the relationship between the spot and forward rates. Frenkel states (1981, p.5) that;

"exchange rates are strongly influenced by 'news' which by definition is unpredictable."

Frenkel tested the efficiency of the market by regressing the logarithm of the current spot rate on the logarithm of the one-month forward rate applicable in the prior month,

for three currencies, the U.S. dollar/sterling, U.S. dollar/French franc and U.S. dollar/deutschemark rates, for the period June 1973 - July 1979. The formula used was ;

$$\ln S_t = a + b \ln F_{t-1} + U_t$$

The results indicated that for the deutschemark/U.S. dollar rate, the hypothesis that the constant term is not significantly different from zero and that the slope coefficient is not significantly different from unity, could not be rejected. Although these hypotheses are rejected for the U.S. dollar/franc exchange rate and marginally rejected for the U.S. dollar/sterling exchange rate, Frenkel states (1981, p.6) that:

"The joint hypothesis that the constant is zero and that the slope coefficient is unity, cannot be rejected at the 95 percent level for the dollar/pound and the dollar/DM exchange rates and at the 99 percent level for the dollar/franc exchange rate."

Frenkel added lagged values of the forward rate in the equation tested, and found that the coefficients of the

lagged values of the forward rate were not significantly different from zero. This is consistent with market efficiency as the forward rate includes the information implicit in the lagged values of the forward rate. The Durban-Watson statistics were found to be consistently close to 2, which indicates an absence of serial correlation.

Frenkel plotted the realized percentage changes in the deutschemark/ U.S. dollar exchange rate and the lagged forward premium for the period July 1973 - July 1979. The forward premium was used to indicate the predicted change in the spot exchange rate. It was found that the variance of the monthly changes in exchange rates materially exceeded the variance in the monthly forward premium. Frenkel concludes (1981, p.11) that this indicates that;

"the bulk of exchange rate changes seem to be due to 'new information' which, by definition, could not have been anticipated and reflected in the forward premium or discount which prevailed in the previous period."

Frenkel plotted the contemporaneous forward rate against the spot exchange rate for the three currencies. The plots reflected a high correlation between forward and spot exchange rates, and a correlation exceeding 96 percent between the percentage changes in the spot and forward exchange rates.

Frenkel (1981, p.15) states that

"the contemporaneous spot and forward exchange rates are approximately equal, thus indicating that the market's best forecast of the future spot rate is (approximately) the current spot rate."

Frenkel states that in general, currencies that are expected to depreciate, are traded at a discount in the forward market.

The study explores the role of "news" in exchange rate movements and based on the assumption that unanticipated changes in interest rates reflects "news", Frenkel formulates the current spot rate as being a function of the forward rate and the unexpected change in interest rates.

The study found that the coefficient of the actual interest differential is not significantly different from zero, while the coefficient of the expected interest differential is positive. However, only in the case of the U.S. dollar/sterling exchange rate, is the coefficient statistically significant.

The expected interest differential was based on lagged values of the interest differential. Frenkel found that during the sample period, which reflected high rates of inflation, the same "news" that caused an increase in the interest differential also caused a depreciation in the spot exchange rate. Exchange rates were found to deviate materially from expected rates based on purchasing power parities.

Isard (1987) in a review of empirical models of exchange rates states that most studies;

"provide extensive and fairly convincing evidence that existing models of systematic exchange rate behaviour could not outperform a naive random-

walk model or the forward exchange rate in postsample forecasting tests..."

However, a few studies have reported models that were able to outperform a random-walk model. Isard states that a number of studies have rejected the hypothesis of uncovered interest parity (UIP).

Frankel and Froot (1985) collected survey data from a few hundred financial market participants and economists on the expected future exchange rate of the U.S. dollar against other currencies. The average expected future exchange rates of a number of currencies were compared to the respective forward rates and significant deviations were recorded. These deviations could reflect risk premiums in the pricing of forward exchange.

Isard (1987) states that exchange rates may be based on a whole range of macro-economic and political factors, exogenous variables affecting production, and taxation factors.

Goodhart (1987) found that unanticipated changes in the UK money stock only affected the U.S. dollar/sterling exchange

on the day after the announcement. This contrasts to the situation in the USA, where there was an almost immediate response to money supply announcements. Goodhart also states that while most tests have found that the exchange rates movements depict a random walk, certain studies have found signs of positive autocorrelation.

Goodhart found that the forward rate was a less reliable predictor of the future spot rate than the current spot rate. The application of Fama's (1984) study to UK data resulted in similar conclusions; the slope coefficient of the regression of the actual change in spot rates to the forward premium was significantly different from unity. Goodhart states that in the U.K. case the foreign exchange market under-reacted to "news".

Edwards (1983) emphasised the role that news has on the spot exchange rate. Using the tests for market efficiency developed by Frenkel and Levich, Edwards found that the market efficiency hypothesis was not rejected for the U.S. dollar/sterling and U.S. dollar/deutschemark rates. However, it was rejected for the French franc/U.S. dollar, and lira/U.S. dollar rate.

Edwards followed the Frenkel procedure of adding F_{t-1} onto the OLS equation and found that the coefficient was not significantly different from zero for all the currencies examined. Edwards modelled "news" on unanticipated changes in domestic and foreign money, domestic and foreign real income and unanticipated changes in real interest rates in both the domestic and foreign country.

When unanticipated changes in the determinants of the exchange rate were taken into account it was found that the lira/U.S. dollar rate met the conditions for market efficiency. However, efficiency was still rejected for the U.S. dollar/French franc exchange rate and Edwards concludes that the "news" reflected in the unanticipated changes in money, income and interest rates do not explain the total variation in exchange rates. This maybe due to a varying risk premium.

Under restrictive assumptions, Kawai (1984) concluded that forward trading would tend to stabilise the spot exchange rate if trade shocks dominated the foreign exchange rate. However, if changes in the interest rate differential is the main cause of exchange rate variability, then forward

trading would tend to increase the volatility in the spot exchange rate.

Chrystal and Thornton (1988) used the equations developed by Frenkel and Levich to test for market efficiency on a set of data for the period March 1973 to November 1983. The currencies examined were of the United Kingdom, France and West Germany. The joint hypothesis that the constant was equal to zero ($a = 0$) and the slope coefficient was equal to unity ($b = 1$) could not be rejected for France and the United Kingdom. However, it was rejected for West Germany.

The "random walk" formulation of the equation was also tested and the joint hypothesis that $a = 0$ and $b = 1$, could not be rejected for the United Kingdom and France. However, again this was rejected for West Germany. Lagged values of the spot and forward rate were added to the equations and the authors were unable to reject the hypotheses that the lag coefficients were not significantly different from zero. The study found that the current spot rate was as good or even a better predictor of the future spot rate than the current forward rate.

Chrystal and Thornton (1988, p.324) add that

"the spot rate contains more information about future spot rates than the forward rate does, because the forward market is typically thinner and involves higher transaction costs."

In an efficient market asset prices would be expected to change instantaneously, when new information which effects future expectations comes onto the market. Hardouvelis (1988) analysed the effects of macro-economic news on the exchange rate. Hardouvelis analysed the immediate response of exchange rates to new information about various US macro-economic factors, including monetary news, inflation, the trade deficit, and other macro-economic factors. The sample period consisted of October 1979 to August 1984.

Hardouvelis examined the U.S. dollar rate in relation to various currencies including the deutschemark, the yen, the Swiss franc, sterling, the French franc, the Canadian dollar and the Italian lira. It was found that the exchange rate reacts primarily to an unanticipated change in money supply (M_1) but that the exchange rate was also

sensitive to changes in the trade deficit, inflation and other variables.

In relation to uncovered interest parity, Frankel (1986) concluded that the risk premium was very small and that very little of the changes in the spot exchange rate which were in excess of the forward premium or discount could be attributed to the risk premium. Frankel concludes that a variable risk premium would not be able to explain the observed bias in the forward rate prediction error.

Hsieh and Kulatilaka (1982) tested for the existence of a risk premium in forward prices for primary metals traded on the London metal exchange over the period January 1970 to September 1980. The authors found evidence to support the concept of a time varying risk premium.

Backus (1984) analysed Canadian and US foreign exchange data over the 1970s. Backus concluded that exchange rate movements reflected a random-walk and that this was consistent with monetary theory if the money supply and income variables also represented random-walks. However, money and income only explain 22 per cent of the exchange rate movements over the sample period. These conclusions

are in line with Meese & Rogoff (1983) who tested the U.S. dollar in terms of various currencies and found that a random walk produced the best post-sample predictions.

Frankel (1982) found that the mean forward forecast error for the six currencies analysed in his study, was not significantly different from zero. Levich (1979[b]) found that the mean forward forecast error was not significantly different from zero. This was taken to conclude that the pricing of forward exchange did not include a risk premium.

In Cornell (1977) although the risk premium was found to have a mean of zero the study concluded that this could be consistent with an exchange risk premium which changed sign over time. Various studies have regressed the future spot rate on the current forward rate to test for the existence of a forward risk premium. If the intercept is equal to zero and the slope coefficient is equal to unity, then the conclusion maybe drawn that forward rate is an unbiased predictor of the future spot rate (therefore, the risk premium is zero).

Frankel (1982) found that the forecast errors for several currencies were serially correlated. Again, this is

consistent with the concept of a time varying risk premium. Cosset (1984) analysed exchange rates over the period March 1973 to February 1980 and found that the size of the risk premium changes over short periods of time and that this indicates that the risk premium may be on average equal to zero.

Shafer and Loopesko (1983, p.21) in analysing the relationship between exchange rate changes and changes in money supply variables, state that;

"Changes in the exchange rate may not have a simple relation to monetary aggregates even when money supply disturbances are the underlying cause. Expectations concerning the future behaviour of money supplies may be much more important than their current behaviour in determining the exchange rate. Thus poor correlation between contemporaneous changes in monetary aggregates and exchange rates can be explained."

The authors state that the uncovered interest rate parity condition consists of a joint hypothesis, firstly, that

identical assets denominated in different currencies are viewed as perfect substitutes and therefore have the same expected rate of return, and secondly that expectations are rational. Empirical evidence seems to suggest that the uncovered interest parity condition is not valid, however, researchers have been unable to determine which hypothesis should be rejected.

The study goes on to state that structural models have not been able to outperform a simple random walk model. This is consistent with the conclusions reached by Meese and Rogoff (1983) who analysed structural models for the deutschmark/U.S. dollar, the sterling/U.S. dollar and yen/U.S. dollar exchange rates. The study concluded that the random walk model performed as well as the structural time series models in the sample period, December 1976 to June 1981.

Shafer and Loopesko (1983), in testing the period April 1973 to February 1983, indicate further evidence to justify the random walk behaviour of exchange rate movements. The authors found that a high percentage of the forecast error was not explained by disturbances in the fundamental factors particularly for short term periods.

The short term volatility in exchange rates is not explained by the variables emphasised in the structural models.

4.4 CONCLUSION

The literature review has been divided into two parts. It firstly represents a survey of studies which test the validity of covered interest parity, and secondly, it represents a survey of methodologies employed to test for the existence of unusual returns for risky investments.

In respect to covered interest parity, numerous studies have provided extensive evidence that the interest parity theorem is valid for securities issued in the Euro-currency markets, whilst deviations from covered interest parity remain, for securities issued in regulated markets. Aliber (1973) emphasised differences in the level of political risk to explain deviations from interest parity while Dooley and Isard (1980) concluded that most of the deviations from covered interest parity, in the German

case, were due to the effective tax that existing capital controls placed on non-resident interest earnings.

The system of capital and exchange controls in the South African foreign exchange market was extensively referred to in Chapters 2 and 3. In Chapter 5 the validity of the covered interest parity theorem will be tested empirically for the South African foreign exchange market in the context of the relevant capital controls.

In respect of risky investments, the empirical support for market efficiency is mixed and less well defined. The analysis of the time series behaviour of spot and forward rates generally lends credence to the Efficient Market Hypothesis in the context of the foreign exchange market. Spot and contemporaneous forward rates are highly correlated, the forward premium/discount is not a good predictor of the future change in the exchange rate and there is substantial empirical support for the observation that the spot exchange rate appears to follow a random walk.

These empirical findings support the view that exchange rates are based on expectations and that the major factor

influencing exchange rate movements is new information, which by definition is unpredictable. The absence of serial correlation in exchange rate movements supports the concept of market efficiency to the extent that traders will not be able to predict the future spot exchange rate based on past movements in the spot rate.

If future exchange rates are generally unpredictable, for whatever reasons, then traders should not be able to outperform a buy-and-hold policy. There are, however, a few studies which have reported varying degrees of serial correlation in exchange rate changes.

Further, in respect to the uncovered interest parity theory, the early evidence supports the hypothesis that the forward rate is an unbiased predictor of the future spot rate. This finding was employed by various studies (see, for example, Levich (1979[c])) to empirically support the concept of market efficiency in the foreign exchange market.

Recently, however, other studies have provided growing evidence that the forward rate is a biased predictor of the future spot rate. This does not necessarily contradict the

concept of market efficiency, for if investors are risk averse to holding forward exchange, then the existence of a risk premium can only be reflected as bias in the forward rate.

This study will test in chapters 6 and 7 the time series behaviour of the Rand/U.S. dollar spot and forward exchange rates, and will provide an analysis of the mean forecast errors. The uncovered interest parity theory will be tested. In addition, the spot rate will be regressed against selected macro-economic variables to determine whether unusual profit opportunities existed over the sample period. In so doing, the study will attempt to offer substance to the concept of market efficiency in the context of the South African foreign exchange market.

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CHAPTER 5

MARKET EFFICIENCY : TESTS FOR COVERED INTEREST ARBITRAGE OPPORTUNITIES*

OBJECTIVE

This chapter tests the validity of covered interest parity and the existence of covered interest arbitrage opportunities in the South African foreign exchange market. In an efficient market risk-free profit opportunities should be quickly eliminated, and covered interest arbitrage opportunities should not exceed related transaction costs.

* The initial findings of this chapter were published in 1987 with Prof. R. Knight, the supervisor at the time. Correia C. de J. and Knight R.F. "Covered Interest Arbitrage Opportunities in the South African Foreign Exchange Market." South African Journal of Business Management, 36, no.4: 209-14.

5.1 INTRODUCTION

This chapter tests the efficiency of the South African foreign exchange market to the extent that risk-free profit opportunities should be quickly eliminated. This represents testing Hypothesis 1, as set out in Chapter 1. Deviations from covered interest parity imply that opportunities exist to undertake profitable covered interest arbitrage transactions.

Interest parity deviations will not imply that the foreign exchange market is inefficient if apparent covered interest arbitrage profit opportunities are not sufficient to offset related transaction costs.

This chapter studies the period August 1983 to February 1988. This period is divided into two sample periods; August 1983 to August 1985, and September 1985 to February 1988. The first period represents a period where technical imperfections were minimal (particularly in the spot market), and the movement in the rand/U.S. dollar rate was dramatic.

The latter period represents a period which covers the imposition of the debt standstill, the reintroduction of the Financial rand mechanism and the imposition of further direct controls.

The chapter defines the terms, covered interest arbitrage and covered interest rate parity and regression analysis is employed to test the relationship between the quoted forward dollar premium and its interest parity value. The interest parity equation is plotted against the quoted forward dollar premium.

Deviations from covered interest parity are analysed and transaction costs are taken into account to conclude on covered interest arbitrage opportunities during the periods under review. The countries under study are limited to South Africa and the U.S.A.

The study found that deviations from covered interest parity did occur during the period August 1983 to August 1985, but these apparent risk-free arbitrage profit opportunities were not sufficient to offset related transaction costs.

Although deviations from interest parity did increase in the period August 1985 to February 1988, except for a limited period, the level of these deviations were not sufficiently material to allow us to conclude that risk-free arbitrage opportunities existed over the period.

Therefore, the study cannot reject the hypothesis that the South African foreign exchange market has met a basic requirement for market efficiency, that is, risk-free profit opportunities should be quickly eliminated.

This conclusion is however subject to the fact that the definition of "risk-free" relates to the absence of exchange rate risk and that political risk remains. The validity of the conclusion rests on the assumption that political risk is not an important variable.

In general, other studies have explained that the reported deviations from covered interest parity in regulated markets are due to such factors as political risk, capital controls and differences in taxation (for example, see Aliber, 1973, and Dooley and Isard, 1980).

In the South African case, the obvious political risk of investing in South African securities, and the extensive system of exchange and capital controls as reported in Chapters 2 and 3, are factors which would be expected to result in deviations from covered interest parity.

The chapter firstly presents the theory underpinning the covered interest parity theorem, then empirically tests for covered interest parity for South African and U.S.A. securities and evaluates the results in terms of other studies and the concept of market efficiency.

5.2 THE SOUTH AFRICAN FORWARD EXCHANGE MARKET

Prior to the implementation of the Commission recommendations, the South African Reserve Bank set the cost of forward cover at a fixed commission rate of one percent per annum. This applied to both purchases and sales of forward foreign currency.

The Reserve Bank's forward cover policy had an important effect on the movement of funds in and out of South Africa. If local interest rates exceeded foreign interest rates by

more than one percent, there existed an incentive for South African importers to obtain finance from foreign sources. Once this occurred however, there existed pressure on the Reserve Bank not to increase the cost of forward cover or reduce local interest rates as this would have an adverse effect on the Reserve Bank's foreign exchange reserves.

The Interim Report of the Commission of Inquiry recommended a policy of setting the forward premium/discount on the basis of interest differentials.. This would reflect an efficient and competitive market as covered interest arbitrage would ensure this relationship in a free and competitive market.

Due to the material foreign exchange losses incurred on the forward account, the Reserve Bank set on a programme to disengage from the forward exchange market by September 1986.

The Reserve Bank introduced a spot-swap system to link the forward market to the spot market (see Gidlow 1986[b]). However, due to economic and political developments disengagement from the forward market has not been possible.

5.3 COVERED INTEREST ARBITRAGE.

Covered interest arbitrage constitutes a swap transaction where parties move funds across boundaries to take advantage of differential interest rates. This arbitrage is risk-free (apart from political risk) in that if a firm borrows U.S. dollars offshore to deposit in South African securities, the firm will simultaneously buy U.S. dollars forward.

If the interest rate differential between South Africa and the U.S.A. is materially different to the forward dollar premium/discount, then an incentive would exist to enter into a profitable arbitrage transaction.

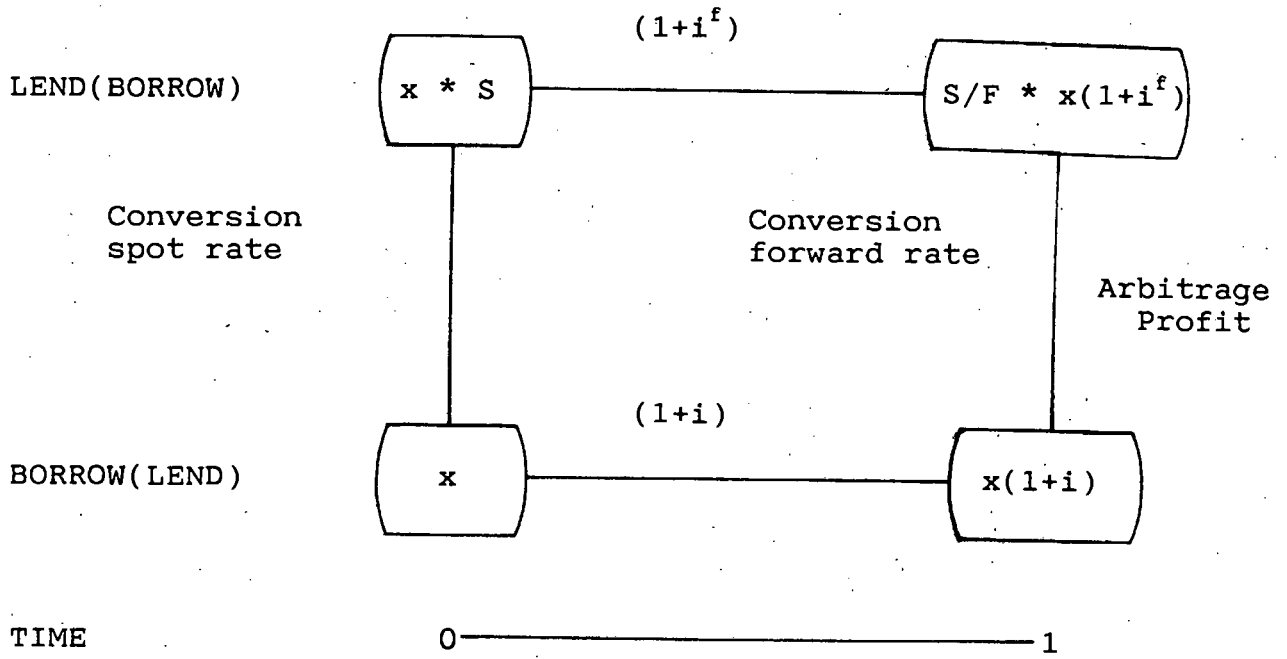
In an efficient market, risk-free arbitrage profit opportunities should be quickly eliminated.

Starting from first principles, we would expect the following equation to be satisfied in an efficient market:

$$x(1+i) - x = x(1+i^f)S/F - x \quad (5.1)$$

where: x = initial amount stated in Rands
 i = domestic interest rate
 i^f = foreign interest rate
 S = spot exchange rate(indirect quotation)
 F = forward exchange rate(indirect quotation)

If Equation 5.1 is not satisfied, there will exist opportunities to enter into profitable covered interest arbitrage transactions, subject to the condition that the inequality is sufficient to offset any related transaction costs. This situation is depicted in Figure 5.1.

FIGURE 5.1 COVERED INTEREST ARBITRAGE FLOW

5.4 COVERED INTEREST RATE PARITY THEOREM (CIPT)

The theory of covered interest rate parity states that for securities of similar risk, the quoted forward premium/discount should be equal to the interest differential divided by one plus the interest rate. The CIPT is a restatement of Equation 5.1 and is mathematically denoted as:

$$\frac{S-F}{S} = \frac{i-i^f}{1+i} \quad (5.2)$$

Where: S = spot exchange rate(indirect quotation)
 F = forward exchange rate(indirect quotation)
 i = domestic interest rate
 i^f = foreign interest rate

Let: Q = (S-F)/S
 I = $(i-i^f)/(1+i)$

5.5 FORWARD DOLLAR PREMIUM

If $Q < I$, then the interest differential is not fully offset by the forward dollar premium. The effect of this inequality is to encourage capital flows into South

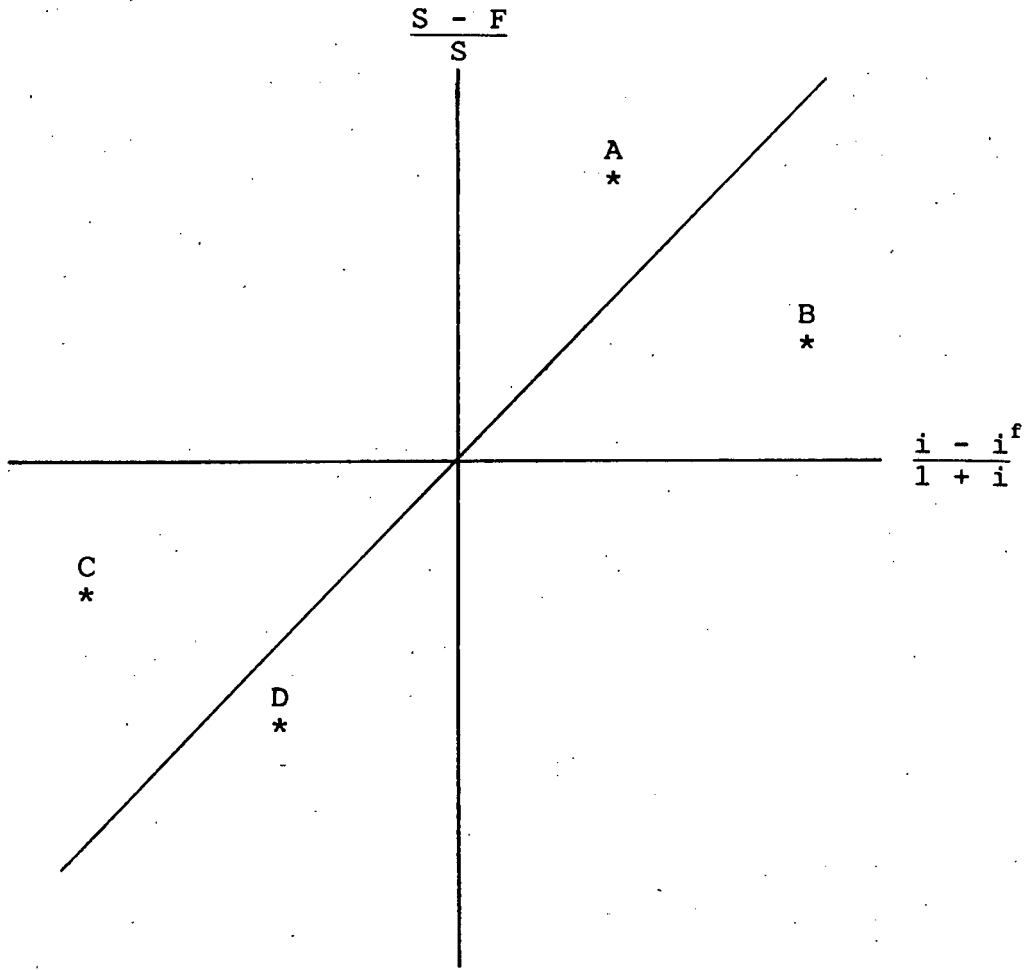
Africa. The demand for spot rands will increase, thereby increasing the value of (S) in the CIPT equation. At the same time the demand for forward U.S. dollars increases, and (F) falls.

This means that the forward premium, (Q) will increase and taking together the effects on relative interest rates due to the movement of funds, covered interest parity will be reinstated.

If $Q > I$, then the quoted forward dollar premium more than offsets the interest differential. This will have the effect of encouraging capital outflows from South Africa. The demand for spot U.S. dollars will increase while the demand for forward U.S. dollars will decline.

Therefore the spot rate, (S) will fall and the forward rate, (F) will rise thereby reducing (Q) to a level that reinstates covered interest parity. The interest parity equation and covered interest arbitrage opportunities are graphically depicted in Figure 5.2.

FIGURE 5.2 COVERED INTEREST PARITY THEORY



All observations on the line represent situations where the interest parity condition is satisfied, i.e. where the forward dollar premium/discount equals the interest differential divided by one plus the domestic interest rate.

Observation A represents a situation where the quoted forward dollar premium exceeds its interest parity value (i.e. $Q > I$). In a perfect market this would result in capital outflows until covered interest parity is restored.

Observation B represents a situation where the quoted forward dollar premium is less than its interest parity value (i.e. $Q < I$). Again, in a perfect world this would result in capital inflows to South Africa to take advantage of the covered interest arbitrage opportunity.

This chapter focuses attention upon situations where the forward dollar premium deviates from its interest parity value. This is due to the fact that for the period under review the forward dollar was consistently at a premium to the spot rate.

Observations C and D reflect situations where the forward dollar discount deviates from its interest parity value. Observation D will result in capital inflows as the forward discount exceeds its interest parity value. As the quoted forward discount is less than its interest parity value in observation C, this will result in capital outflows.

Covered interest arbitrage will not necessarily restore covered interest parity due to the transaction costs involved in the required buying and selling operations. Therefore, market efficiency requires that the interest parity equation is satisfied to the extent that the observations lie within the transaction cost boundaries around the CIPT line.

5.6 DATA

A regression was run on Micro TSP (version 4.1) to test the covered interest parity equation for the period August 1983 to February 1988. Data were obtained from the

International Division of the Standard Bank or downloaded from the Standard Bank's CATS system.

The data consists of 233 weekly observations of the three monthly South African and New York Bankers' Acceptance rates, the weekly spot rand/U.S. dollar rates and weekly three month quoted forward dollar premiums.

The data represents the closing rates on the last business day of each week. The Bankers' Acceptance rates are the market rates quoted in the secondary market and are before any bank commission and stamp duty. As the data is stated in annualised terms it is necessary to transform the data by dividing by four. Transformation is necessary otherwise the relationships between the variables will be misspecified. The division of the annualised rates by four represents estimates of the effective rates facing traders.

The tests for covered interest parity require that securities of similar risk be compared. Bankers' Acceptance rates were selected to test for interest parity. It will be noted that there remain differences in terms of political risk, taxation and capital controls.

Covered interest parity was also tested by using the monthly prime overdraft rates quoted in South Africa and the U.S.A. to predict the forward rate. The period was confined to the period January 1983 to October 1986, due to limitations in the Standard Bank's CATS data bank. Due to the greater degree of stickiness in prime overdraft rates, and the volatility in the foreign exchange market over this period, this was considered to be an important test of covered interest parity.

The data consists of the month-end closing prime overdraft rates in South Africa and the U.S.A. and the month-end quoted one month forward dollar premium. The data was transformed by dividing by twelve to represent estimates of the rates facing traders.

5.7 RESULTS

In Figure 5.3, the quoted forward dollar premium (Q) is plotted against its interest parity value (I) for the period August 1983 to February 1988.

The quoted dollar premium has tended to follow its interest parity value very closely over the period, except in the latter half of 1985 and for a period in 1986. This may reflect the turbulence in the market in the aftermath of the imposition of the debt standstill, and the closure of the foreign exchange market for a limited period.

It will be noted that from 1986, the quoted dollar premium appears to have consistently remained below its interest parity value. The magnitude of these deviations is analysed in greater detail further in the study.

Figures 5.4 and 5.5 represent plots of the quoted dollar premium and its interest parity value over the two sample periods August 1983 to August 1985 and September 1985 to February 1988.

The first sample period, August 1983 to August 1985, reflected a period of a systematic relaxation in direct controls, the implementation of market reforms and the adoption of a flexible spot exchange rate system. In this period the forward dollar premium appeared to follow its interest parity value very closely.

The latter period reflects increased deviations from covered interest parity. During September 1985, these deviations are significant, perhaps reflecting the turbulence in the market subsequent to the debt standstill, political turmoil and the closure of the foreign exchange market.

FIGURE 5.3 THE RELATIONSHIP BETWEEN INTEREST PARITY AND THE QUOTED FORWARD DOLLAR PREMIUM.

August 1983 - February 1988

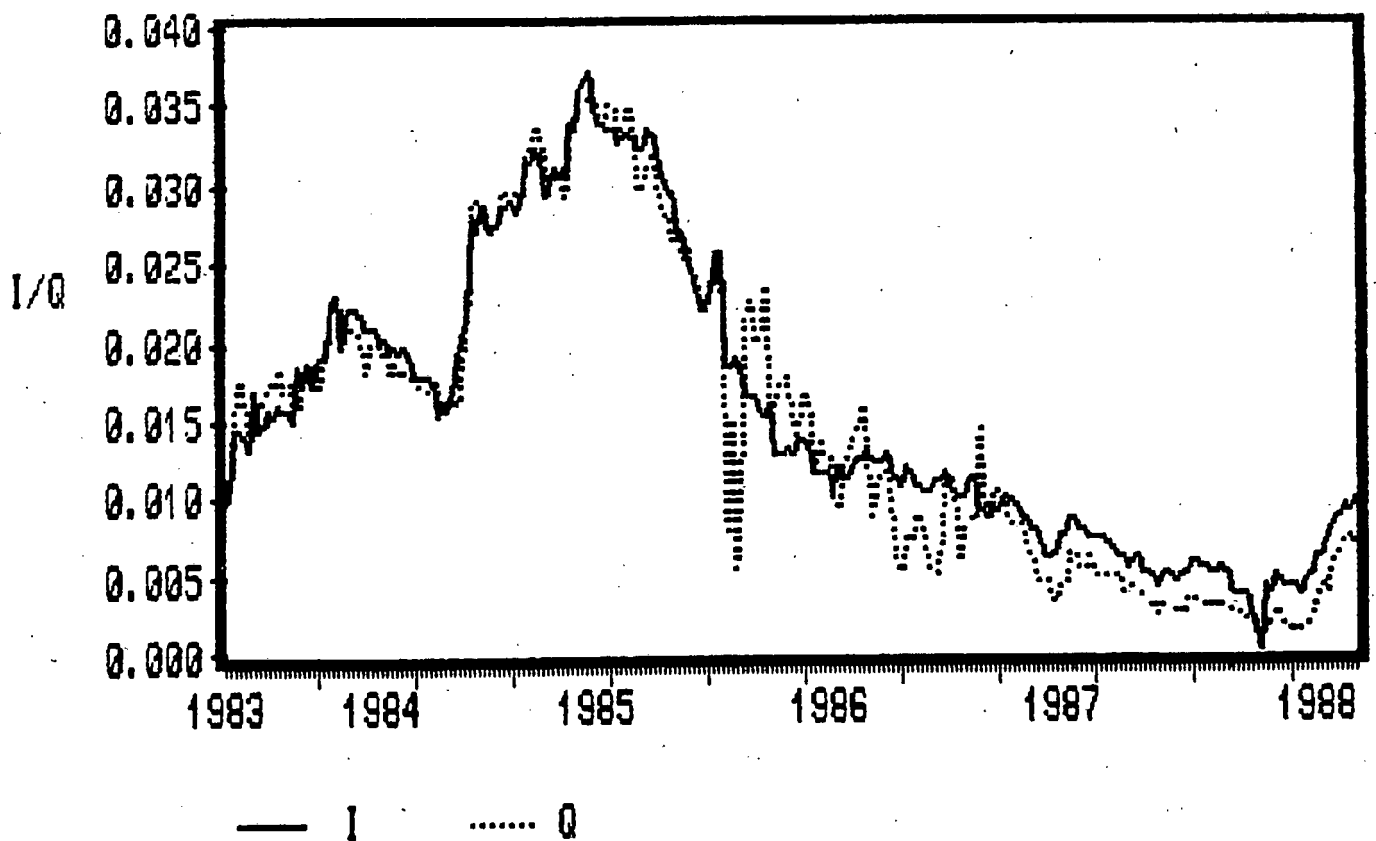


FIGURE 5.4 THE RELATIONSHIP BETWEEN INTEREST PARITY AND
THE QUOTED FORWARD DOLLAR PREMIUM.

August 1983 - August 1985

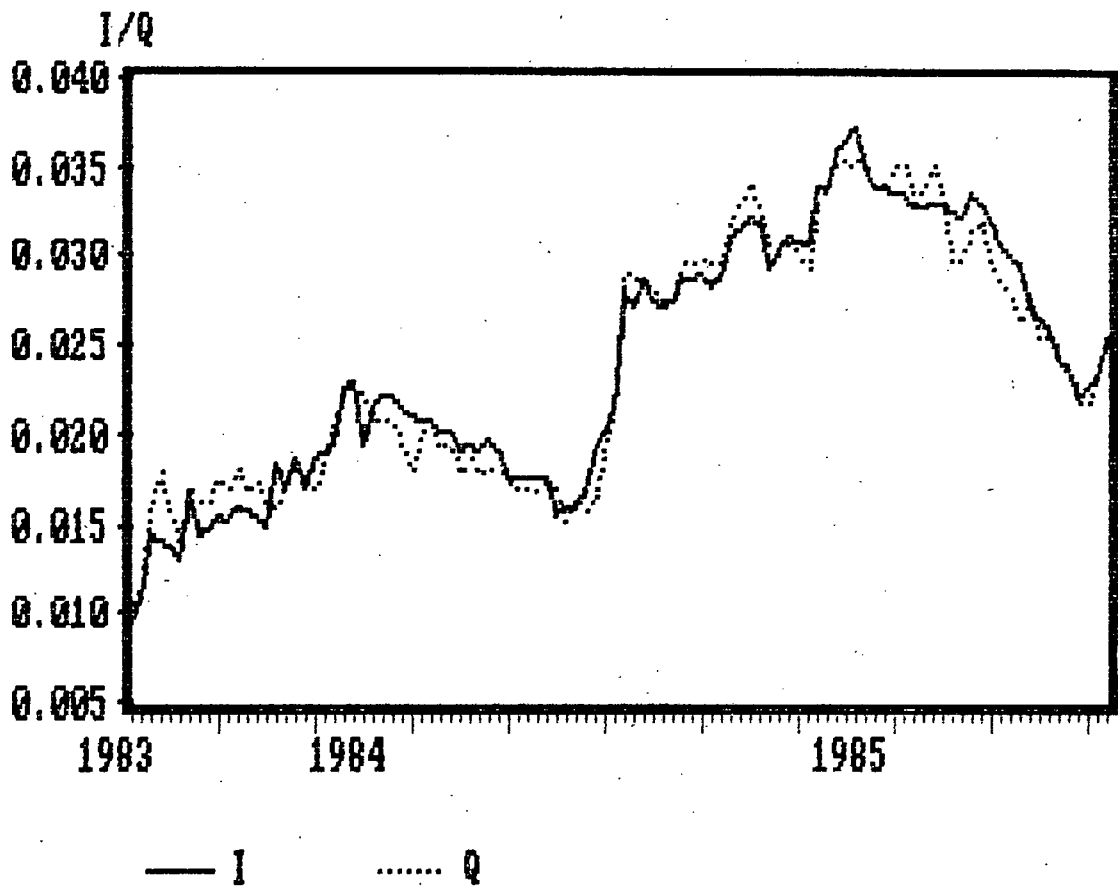
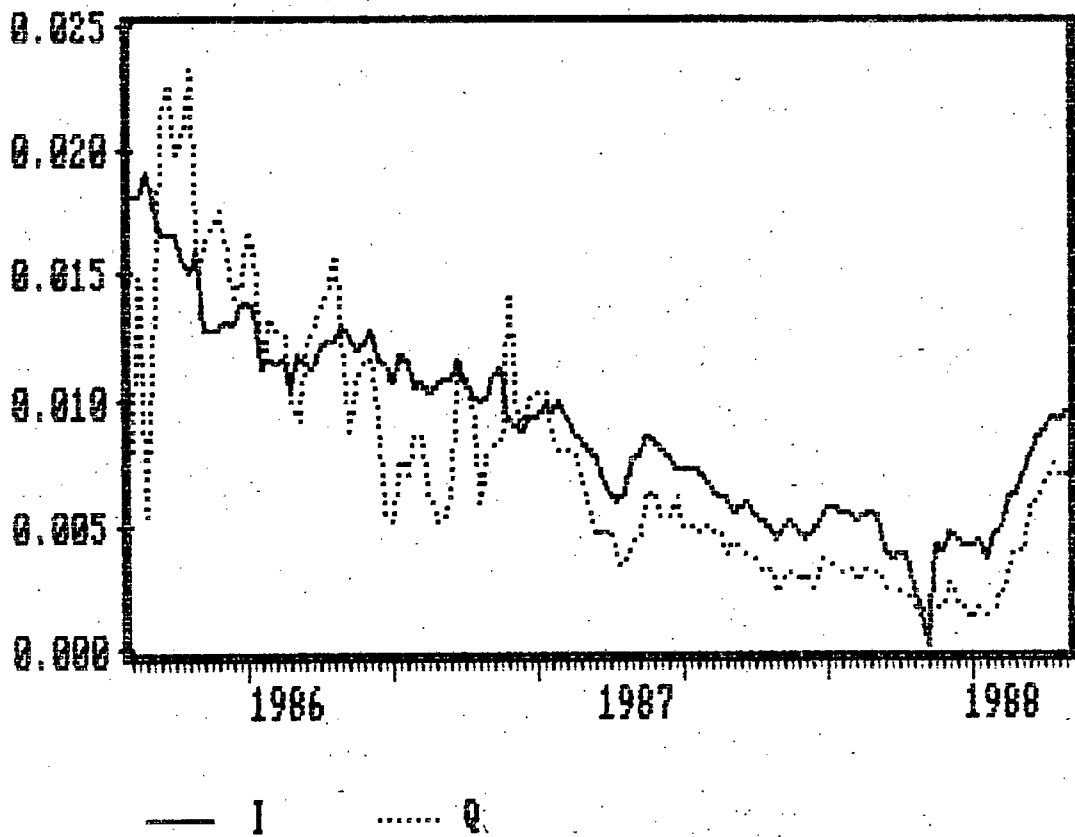


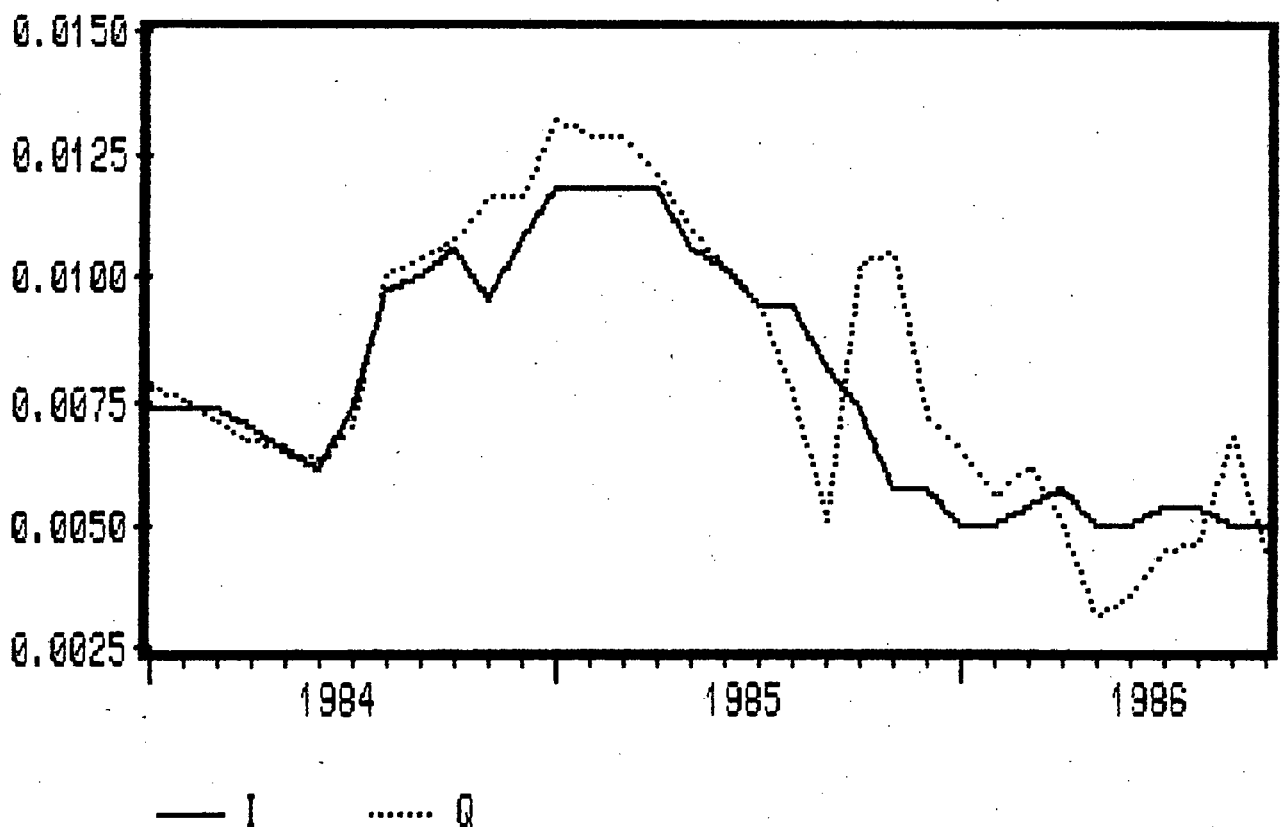
FIGURE 5.5 THE RELATIONSHIP BETWEEN INTEREST PARITY AND
THE QUOTED FORWARD DOLLAR PREMIUM.

September 1985 - February 1988



In Figure 5.6, the quoted monthly forward dollar premium (Q) is plotted against its interest parity value (I) which is determined by using the month-end prime overdraft rates in South Africa and the U.S.A. for the period January 1984 to October 1986. Deviations appear to be material in 1985. The deviations will be analysed in greater detail further on in the chapter.

FIGURE 5.6 THE RELATIONSHIP BETWEEN INTEREST PARITY AND
THE QUOTED FORWARD DOLLAR PREMIUM
(Based on prime overdraft rates)
January 1983 - October 1986



5.8 REGRESSION EQUATION

The following regression equation was specified:

$$Q = a + bI + u_t \quad (5.3)$$

where :

$$Q = (S - F)/S$$

$$I = (i - i^f)/(1+i)$$

$$u_t = \text{white noise term}$$

The spot exchange rate (S) and the forward rate (F) are stated in terms of indirect quotations.

5.9 REGRESSION ESTIMATES

The results of the regression equation for the period August 1983 to February 1988 are presented in Table 5.1. The covered interest parity theory requires that the slope coefficient should be close to unity. The regression results in a slope coefficient of 1.06.

Covered interest parity implies that the constant, a , should not be significantly different from zero. However, the t statistic indicates that the constant in the equation, is statistically significant and negative.

The R^2 is 94.9 percent indicating a high degree of correlation between the quoted dollar premium (Q) and its interest parity value (I).

To correct for autocorrelation, the data has been transformed using the Cochrane-Orcutt technique. The results of the revised equation are also presented in Table 5.1.

The slope coefficient is 1.04 which is not statistically different from unity at the 99 percent confidence level and the R^2 is 96.8 percent. The constant term remains statistically significant after transformation. The Durbin-Watson (DW) statistic is now 2.11 indicating the correction for serial correlation.

TABLE 5.1 **RESULTS OF REGRESSION EQUATION: $Q_t = a + bI_t + u_t$**
 (t statistics in parentheses)

August 1983 - February 1988

	\hat{a}	t_a	\hat{b}	t_b	R^2	DW
1	-0.0018	(-6.23)	1.058	(3.58)	94.9%	0.78
2	-0.0015	(-2.62)	1.038	(1.17)	96.8%	2.11

August 1983 - August 1985

	\hat{a}	t_a	\hat{b}	t_b	R^2	DW
1	0.0008	(1.65)	0.96	(-2.12)	96.3%	0.83
2	0.0016	(1.62)	0.92	(-2.05)	97.5%	2.10

September 1985 - February 1988

	\hat{a}	t_a	\hat{b}	t_b	R^2	DW
1	-0.0026	(-4.29)	1.125	(1.99)	71.2%	0.77
2	-0.0022	(-1.86)	1.081	(0.65)	81.5%	2.05

1 = Ordinary Least Squares Regression

2 = Cochrane-Orcutt transformation

The regression estimates for the two sample periods, August 1983 to August 1985, and September 1985 to February 1988 are also presented in Table 5.1. This was done to analyse differences between the two periods which in effect reflected two different exchange rate regimes.

The first period reflects a unitary, "managed floating" exchange rate system with minimal central bank intervention in the spot market, and a continuing relaxation in exchange controls. The latter period reflects the reimposition and expansion of direct controls, the reintroduction of the Financial rand mechanism and a reversal in the market reform process.

In the sample period, August 1983 to August 1985, the constant term is 0.0008 and the slope coefficient is 0.96. The constant term is not significantly different from zero which is in contrast to the value of the constant term for the period as a whole.

The slope coefficient is significantly different from unity and remains significantly different from unity after applying the Cochrane-Orcutt transformation. The slope coefficient is 0.92 after applying the Cochrane-Orcutt transformation.

The latter sample period, September 1985 to February 1988, reflects different results. The constant term is negative (-0.0026) and is statistically significant; after applying the Cochrane-Orcutt transformation, the estimate for the constant term is no longer significant at the 95 percent confidence level.

The slope coefficient is 1.125 and is significantly different from unity at the 95 percent confidence level but not at the 99 percent confidence level. The Cochrane-Orcutt transformation does not materially alter the slope coefficient (1.0813) and the coefficient is no longer significantly different from unity.

5.10 COVERED INTEREST ARBITRAGE OPPORTUNITIES

The question is whether any risk-free arbitrage opportunities existed over the sample period? The following equation was formulated to test for the

existence of profitable covered interest arbitrage opportunities:

$$D = Q - I$$

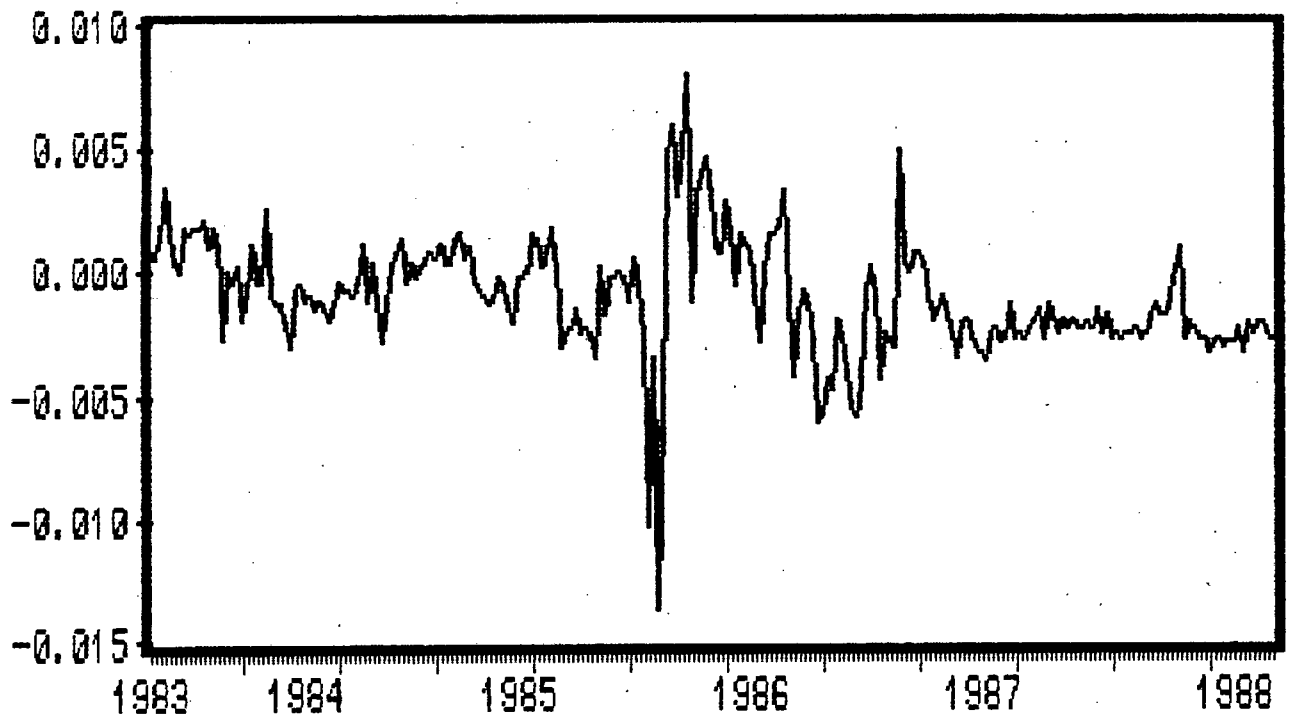
where: D = Deviation from interest parity

Q = Quoted forward U.S. dollar premium

I = Interest parity value

FIGURE 5.7 DEVIATIONS FROM COVERED INTEREST PARITY

August 1983 - February 1988



— Deviations from interest parity

The summary statistics for the deviations depicted in Figure 5.7 are presented in Table 5.2. The mean deviation over the total sample period is only minus 0.09 percentage points and the standard deviation is 0.24 percentage points. The maximum positive deviation is 0.81 percentage points and the largest negative deviation is -1.37 percentage points.

The maximum and minimum values relate to the month of September 1985 which reflected a period of market turbulence, the imposition of further exchange controls and the closure of the market for a limited period. The effect of the debt standstill and the adoption of stringent exchange controls is emphasised when the period is divided into two sample periods, August 1983 to August 1985, and September 1985 to February 1988.

It will be noted that for the first period August 1983 to August 1985, deviations from covered interest parity did not exceed 0.34 percentage points. The mean deviation is only minus 0.02 percentage points and is not significantly different from zero. Two thirds of the deviations lie within approximately 0.14 percentage points of the mean.

In the latter period, the mean deviation is minus 0.15 percentage points with a standard deviation of 0.28 percentage points. The maximum and minimum values for the total period were recorded in September 1985 which forms part of this sample period. Again, although the mean deviation is greater than the mean deviation for the first sample period, it is still not significantly different from zero.

**TABLE 5.2 SUMMARY STATISTICS : DEVIATIONS FROM COVERED
INTEREST PARITY**

August 1983 - February 1988

Mean	SD	Max	Min
- 0.0009	0.0024	0.0081	-0.0137

August 1983 - August 1985

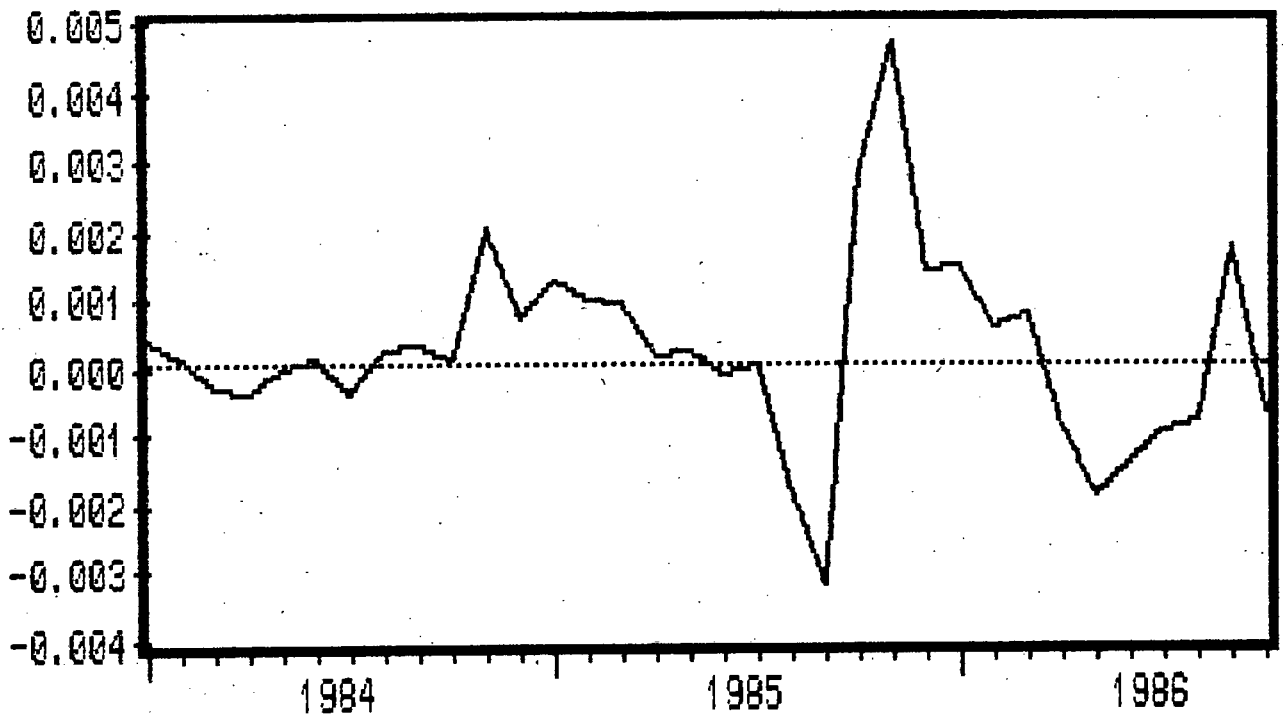
Mean	SD	Max.	Min.
-0.0002	0.0014	0.0034	-0.0034

September 1985 - February 1988

Mean	SD	Max	Min
- 0.0015	0.0028	0.0081	-0.0137

Deviations from covered interest parity using monthly prime overdraft rates and monthly forward rates, are depicted in Figure 5.8. The deviations from interest parity are significant in the latter half of 1985 which adds emphasis to the results presented using the Bankers' Acceptance rates.

FIGURE 5.8 **DEVIATIONS FROM COVERED INTEREST PARITY**
(Using prime overdraft rates)
January 1983 - October 1986



The summary statistics are presented in Table 5.3. The mean monthly deviation is 0.027 percentage points with a standard deviation of .143 percent. The maximum and minimum deviations are 0.475 and 0.317 percent respectively.

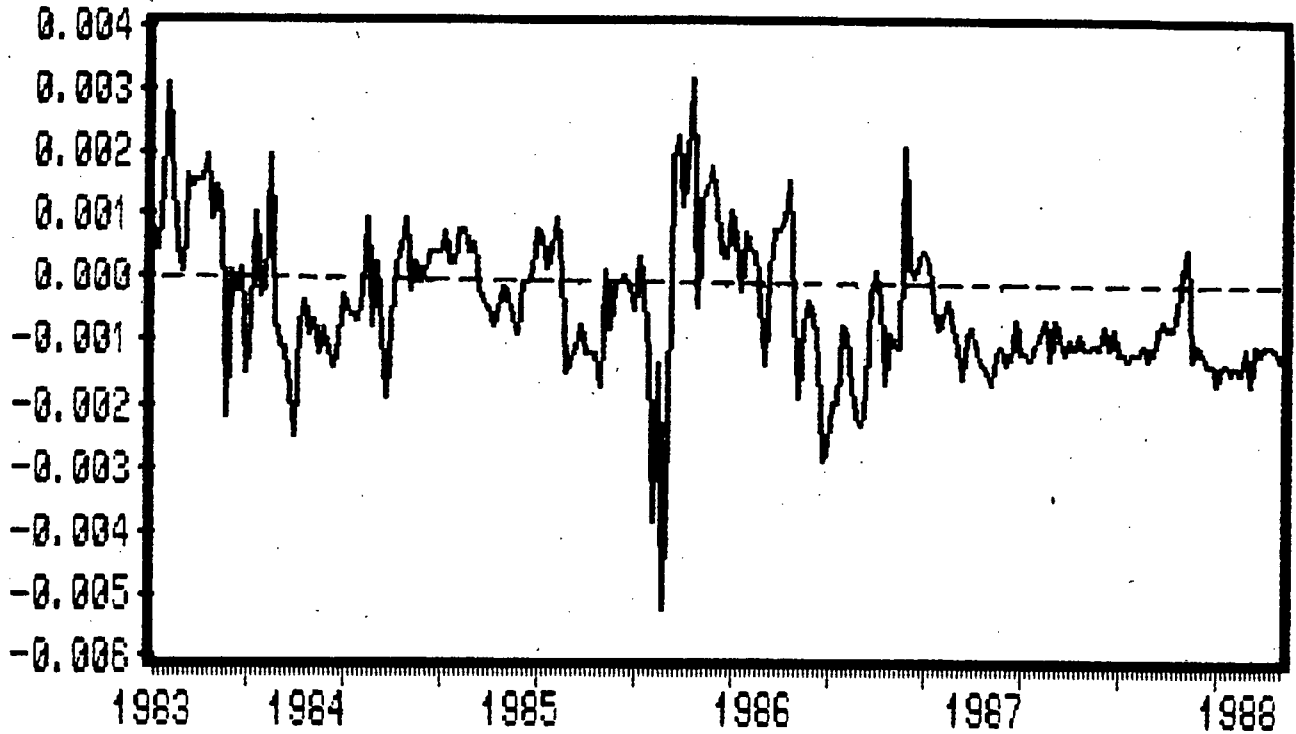
TABLE 5.3 **SUMMARY STATISTICS : DEVIATIONS FROM COVERED INTEREST PARITY**
(Using prime overdraft rates).

Mean	SD	Max.	Min.
0.00027	0.00143	0.00475	-0.00317

Deviations from covered interest parity have been expressed in terms of percentage points. To determine the covered interest arbitrage opportunity spread, it is necessary to translate the interest parity percentage deviations into exchange rate points. This is achieved by multiplying the percentage deviations by the spot exchange rate at each point in time. Deviations in terms of exchange rate points are presented in Figure 5.9.

**FIGURE 5.9 COVERED INTEREST ARBITRAGE OPPORTUNITY
SPREADS***

August 1983 - February 1988



— Deviations from interest parity (points)

The summary statistics of covered interest parity deviations in terms of exchange rate points are presented in Table 5.4. The mean is minus 4.4 exchange rate points with a standard deviation of 11.2 points. The maximum and minimum deviations are 31 and 52 points respectively. In the period August 1983 to August 1985, the mean is very

* As Figure 5.9 represents deviations stated on the basis of exchange rate points, and the Rand has generally depreciated over the period under study, deviations in the early period (if compared to Figure 5.3) are magnified in relation to later periods.

close to zero. The mean deviation is less than one exchange rate point. For this period, two thirds of the deviations are within 10 points of the mean. The maximum and minimum deviations are 31 and 25 exchange rate points respectively. In the period September 1985 to February 1988, the mean is a minus 7.1 exchange rate points which is greater than the mean deviation of 0.8 points for the first sample period but is not significantly different from zero.

**TABLE 5.4 SUMMARY STATISTICS : DEVIATIONS FROM COVERED
INTEREST PARITY - EXCHANGE RATE POINTS**

August 1983 - February 1988

Mean	SD	Max.	Min.
-0.00044	0.00112	0.00312	-0.00521

August 1983 - August 1985

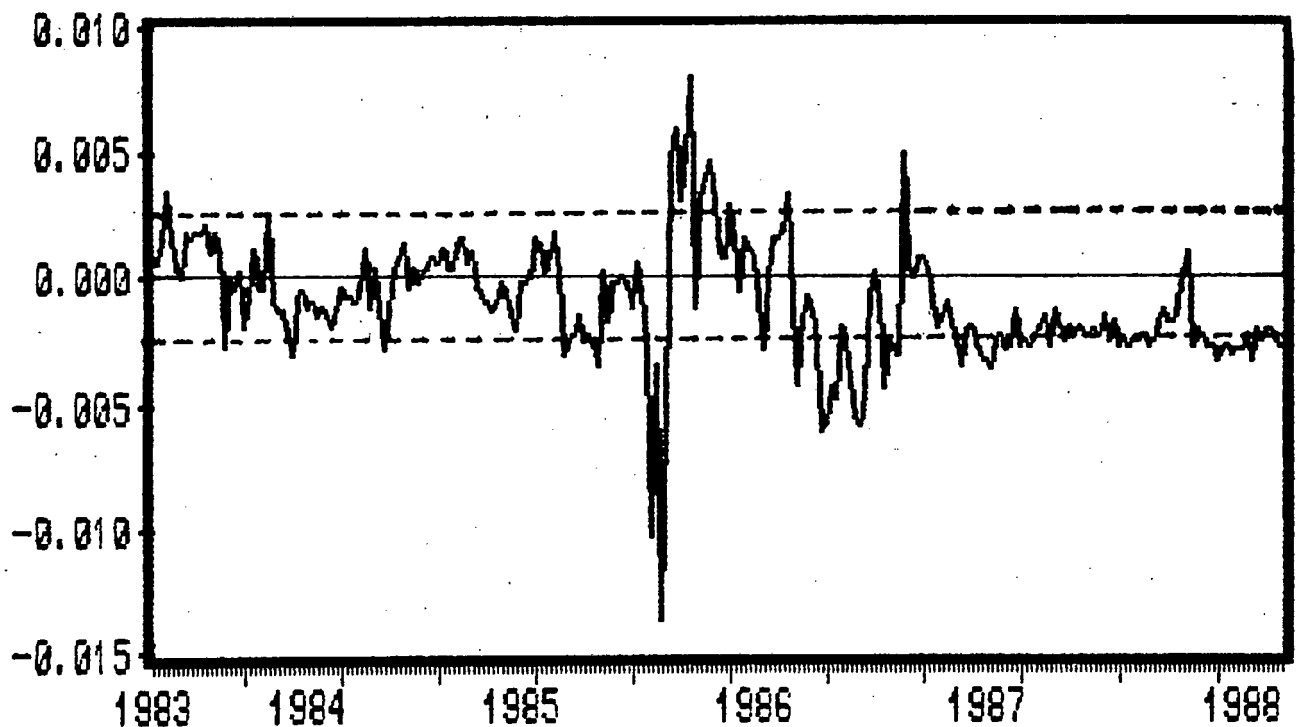
Mean	SD	Max.	Min.
0.00008	0.00097	0.00310	-0.00250

September 1985 - February 1988

Mean	SD	Max.	Min.
-0.00071	0.00115	0.00312	-0.00521

From January 1987 to February 1988, when the forward dollar premium remained consistently below its interest parity value, the magnitude of these deviations was insufficient to influence capital inflows as these deviations did not exceed the relevant transaction costs.

FIGURE 5.10 DEVIATIONS FROM INTEREST PARITY
(0.25% transaction cost boundaries).



Transaction costs in the foreign exchange market may be measured in terms of exchange rate points. This is reflected in the bid-ask spread facing traders. Rand/U.S. dollar bid-ask spreads at the retail level (for smaller amounts) are presented in Table 5.5 for specified dates.

TABLE 5.5 **BID-ASK SPREADS IN SPOT AND FORWARD RATES**

Rand Bid rates/Rand Ask rates stated in U.S.Dollar terms.

Date	Spot			Forward		
	Bid	Ask	Spread	Bid	Ask	Spread
30/05/84	0.7690	0.7790	100pts	0.7518	0.7672	154pts
30/08/84	0.6365	0.6465	100pts	0.6193	0.6305	112pts
30/11/84	0.5315	0.5415	100pts	0.5149	0.5272	123pts
28/02/85	0.4985	0.5085	100pts	0.4806	0.4926	120pts
30/05/85	0.4970	0.5070	100pts	0.4827	0.4947	120pts
27/08/85	0.3700	0.3800	100pts	0.3670	0.3790	120pts

At the retail level, the spot market has reflected a spread of 100 points whereas the spread on the forward market is approximately 120 points. These spreads are clearly not relevant for a firm which would be transacting with large amounts but the magnitudes of these spreads may indicate inefficiencies at the retail level.

In the interbank market the bid-ask rates reflect significantly reduced margins. The average spread is approximately 8-10 points in the spot market.¹ The bid-ask spread is slightly wider in the forward market.

A swap transaction involves a spot and a forward transaction. If we assume the spread facing a blue chip corporate client is 8 points in the spot market and 10 points in the forward market, then the average spread facing an arbitrageur for both legs of the swap transaction would be 9 points.

1 As banks are dealing on a transaction basis for buy/sell orders it is difficult to obtain data on the spreads facing arbitrageurs. According to private interviews by the writer, the spread in the spot market is approximately 8-10 points. Also, see Gidlow (1980[b]).

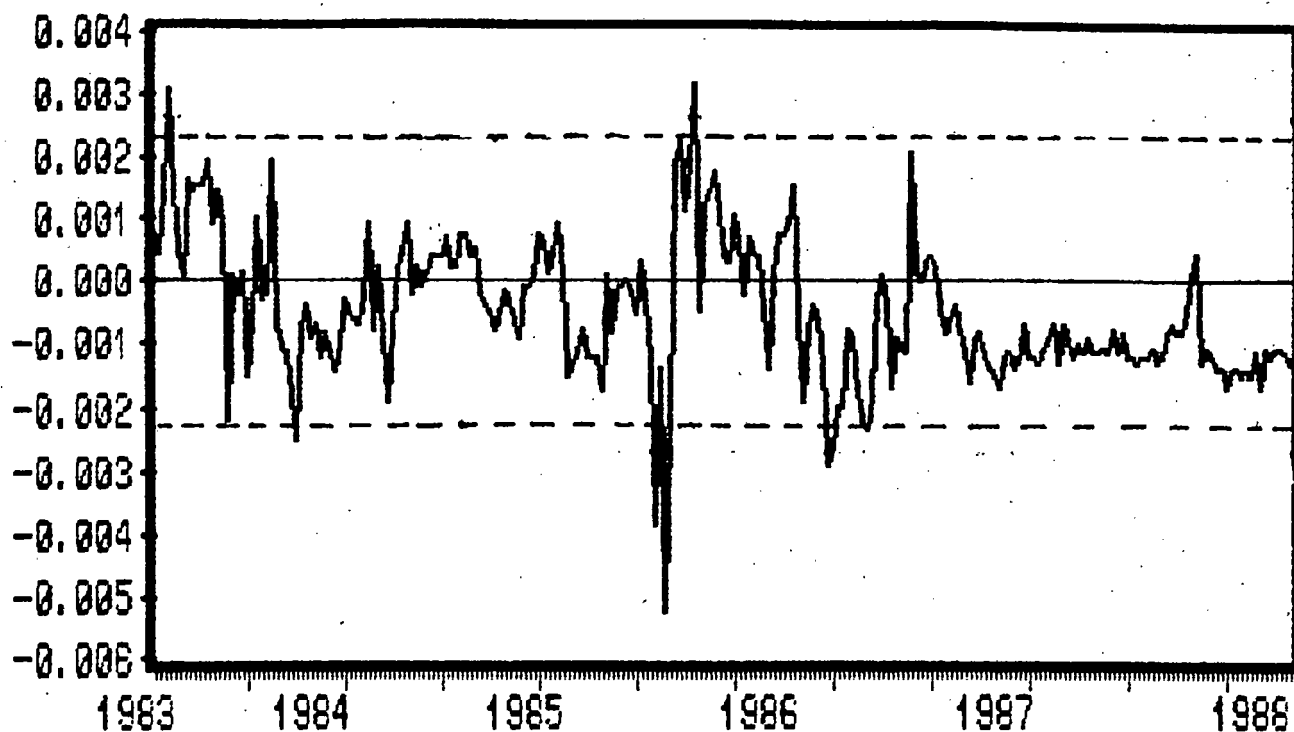
Demsetz, in a study of the U.S. foreign exchange market, found that transaction costs in buying and selling securities were on average 2.5 times the costs of transacting in the foreign exchange market.

If we apply this ratio to the average spread facing an arbitrageur of 9 exchange rate points in the foreign exchange market, then the level of transaction costs facing arbitrageurs would be 22.5 exchange rate points.

In Figure 5.11, point deviations from interest parity are plotted with transaction cost boundaries of 22.5 exchange rate points. This results in a wider band than the transaction cost boundaries employed by Levich (1979[b]) and Clendenning (1970).

Apart from September 1985, there were only three times when deviations from covered interest parity exceeded 22.5 points, and then only marginally so.

FIGURE 5.11 DEVIATIONS FROM INTEREST PARITY
(Exchange rate points)



The interest data reflect Bankers' Acceptance rates quoted in the secondary market and excludes acceptance commission and stamp duty. The acceptance commission and stamp duty represents the transaction costs involved in undertaking Banker acceptance finance.

The acceptance commission is approximately 1.5 percent per annum of the nominal value, and stamp duty amounts to 5

cents for every R100 (0.05%). For "blue chip" corporate clients, the acceptance commission amounts to 0.25 percent per annum.

The cost of the acceptance commission facing a blue chip corporate client for a three month transaction would be:

$$0.25/100 \times 3/12 = 0.06 \text{ percent}$$

The stamp duty is 0.05/100, that is, 0.05 percent. The total transaction cost on Bankers' Acceptances would therefore amount to 0.11 percent for "blue chip" traders.²

Therefore, "blue chip" corporate clients would face transaction costs of 0.11 percent on the money market transaction and at least 8 exchange rate points in the foreign exchange market. At an average exchange rate of R1 = \$0.50, this would amount to a bid-ask spread of 0.16 percent.

Therefore the transaction costs facing a "blue chip" corporate client, before taking into account the costs involved in dealing in U.S. bankers acceptances, would amount to 0.27 percent. This estimate offers support

² Source: Private Interview with Ina Terblanche of Investec Bank, Cape Town.

(assuming minimal costs in the U.S.) for the 0.25 percent transaction cost boundaries used in Figure 5.10.

Although banks would face a reduced level of transaction costs in dealing with Bankers' Acceptances in the secondary market, with the reported turn being an estimated 0.1 percent per annum (i.e. 0.025 percent per 3 months), arbitrage transactions by the banks are restricted by the requirements of the Bank's Act.

This substantiates the view taken by C. Viettri of First National³ who required deviations from interest parity to be in the order of 1-2 percent before the bank would undertake any arbitrage transactions. Apparently, the level of arbitrage transactions being undertaken by the banks was insignificant. The requirements of the Bank's Act constrains arbitrage activities due to the Act's liquid asset and profitability requirements.

If firms are able to transact at the reported margins of 0.1 percent per annum then the transaction costs would amount to at least 0.21 percent (i.e. $0.16\% + 0.025\% \times 2$). Therefore the transaction cost boundaries employed in this

3 Private interview with the writer

study appear to be reasonable estimates of the actual transaction costs facing traders.

The deviations from covered interest parity using monthly prime overdraft rates and monthly forward rates are depicted in Figure 5.12, with transaction cost boundaries which are assumed to amount to at least 0.20 percentage points.

In the foreign exchange spot market the bid-ask spread facing traders would tend to be independent of the investment period. A bid-ask spread of 0.16 percent, and a further cost margin of 0.04 percent is plotted on the graph to depict a 0.20 percent boundary, where transaction costs would offset any arbitrage opportunity.

This is depicted in Figure 5.12. Significant deviations from interest parity were recorded for the months of August, September and October 1985. This may reflect the turbulence in the market in the aftermath of the market

5.12 INTERPRETATION AND COMPARISON

McCormick (1979) found that when using Reuters data, transaction costs explained only 38 percent of the deviations from interest parity using U.S. and U.K. Treasury Bills. These represent securities issued in different political jurisdictions.

In contrast, McCormick found that 100 percent of the deviations from interest parity for securities issued in the same political jurisdiction (Euro-sterling and Euro-dollar deposits) could be explained by transaction costs. McCormick (1979, p.416) goes on to state that:

"These results do not seem unreasonable. The United Kingdom has long had very stringent capital controls. These controls have frequently caused large discrepancies between domestic sterling and Euro-sterling interest rates, and one would expect them to also have caused large discrepancies from covered interest arbitrage parity between U.S. and U.K. treasury bills. On the other hand, the absence of such controls in the Euro-currency markets makes it

much more likely that discrepancies from covered interest arbitrage parity between Euro-dollars and Euro-sterling are due only to transaction costs."

Aliber (1973) found that the mean deviation from interest parity is seven times greater when U.K. and U.S. treasury bills are used to predict the forward rate than when external dollar and sterling deposits are used. Aliber (1973, p.1455) goes on to state that:

"a major source of the difference between predicted and observed forward rates is that the securities used to predict the forward rate are not identical in terms of political risk."

Aliber recognises that exchange controls may restrict the ability of investors to take advantage of deviations from interest parity, and thereby re-establish interest parity through equilibrating capital flows. Further, investors may face different tax rates and therefore the quoted interest yields do not reflect effective yields.

Dooley and Isard (1980) emphasised the role of capital controls and differences in political risk in explaining deviations from interest parity. Isard (1987) concludes that deviations from covered interest parity are immaterial when Euro-currency rates are employed, while deviations from covered interest parity for securities issued in different political jurisdictions are due to capital controls or varying political risks.

In conclusion, studies have generally reported deviations from covered interest parity for securities issued in regulated markets, while covered interest parity is valid for securities issued in unregulated markets. The conclusions reached in these studies draw an interesting contrast to the results reported in this thesis

This chapter concluded based on empirical tests over the period August 1983 to February 1988, that covered interest parity was valid in the South African foreign exchange market, except for limited periods, when using 3 monthly Bankers' Acceptance rates and prime overdraft rates to predict the forward rate.

relatively high, as South Africa has imposed a wide ranging system of exchange controls. The imposition of the debt standstill, the readoption of the Financial rand system represents evidence that the level of uncertainty relating to future capital controls is high. Further, political risk as more widely defined, and relating to political and socioeconomic stability and the local consequences of investment in South Africa for U.S. entities, would be factors limiting U.S. investment in South African securities.

The material Financial rand discount indicates the premium required by foreign investors to compensate for the level of political risk involved in investing in South African securities.

However, it is not correct to compare returns earned by non-residents using the Financial rand mechanism to returns using the Commercial rand, due to the fact that the Financial rand is more volatile, there is limited forward cover available, and it is an extremely thin market. A transaction of R5 million can have a significant effect on the Financial rand rate.⁴

⁴ Source: Private interview with Mr. Pike of Exchange Control, S.A. Reserve Bank.

South Africa has a system of extensive exchange and capital controls, which limit the ability of arbitrageurs from taking advantage of deviations from interest parity. These controls have been cited in detail in Chapters 2 and 3. Residents are (legally), severely restricted in their ability to move funds into foreign securities. Non-residents are also subject to exchange controls.

A specific restriction which applies to non-residents and particularly non-resident banks, is that these banks are not permitted to trade in bearer documents such as bankers' acceptances [see Gidlow (1984[d])]. South Africa's system of exchange controls would be expected to restrict the ability of arbitrageurs from undertaking equilibrating capital flows to re-establish covered interest parity.

Therefore, deviations from interest parity could remain for sustained periods of time. The liquid asset requirements and the required capital reserve ratios would tend to discourage equilibrating capital flows [see Gidlow (1984[d])].

There is an alternative argument; exchange controls are ineffective and therefore would not be relevant in explaining deviations from covered interest parity in the South African foreign exchange market. The large short-term capital outflows reported in Chapter 3, despite an extensive system of exchange controls lends credence to this view.

Differences in the taxation of security income would also result in deviations from covered interest parity when nominal interest rates are compared. In this case the nominal rate would not represent the effective rate. This however, would require a period-by-period comparison due to ongoing changes in tax legislation.

Normally, non-residents who are investing funds in South African securities, would not be taxable as South African tax entities. Non-resident Tax on Interest (NRTI) [Section 64a] was repealed by Act 90 of 1988. This had represented a 10 percent withholding tax on interest paid to non-residents.

In the U.S.A., corporations are taxed on worldwide income.

The marginal rate is currently 34 percent. The U.S. entity is allowed to deduct foreign taxes paid as a credit to its U.S. tax liability. In New York, entities are further subject to State taxes of 10 percent.

In 1987, the Rangle Amendment passed by Congress withdrew the tax credit for South African tax paid by U.S. entities operating in South Africa. The difference in the tax rate (including state taxes) faced by South African companies and U.S. companies is presently only 6 percent, if these companies are not registered as tax entities in both countries, but only act as arbitrageurs to take advantage of deviations from interest parity.

However, the inclusion of tax would require a period-by-period comparison of the tax legislation in both countries. Although outside the ambit of this thesis, this would represent a useful avenue for future research on covered interest parity

5.13 CONCLUSION

This study was not able to reject Hypothesis 1 as specified in Chapter 1. The South African foreign exchange market is efficient to the extent that covered interest arbitrage opportunities are quickly eliminated.

This is based on the assumption that the covered interest arbitrage opportunities were risk-free. The results of the study are generally in contrast to other studies which reported deviations from covered interest parity in regulated markets.

The results, except for a limited period, are consistent with what would be expected to occur in a free and competitive market and is consistent with the results of studies on unregulated markets.

The Reserve Bank has set the price of forward exchange on the basis of what would be expected to occur in a competitive market.

The forward exchange losses incurred by the Reserve Bank

on parastatal borrowings would support the view that deviations from interest parity are not a feasible policy alternative.

The fact that deviations from covered interest parity were insignificant over the sample period has implications for the decision by South African companies to obtain offshore finance. In the period 1982-1985 South African companies undertook significant levels of foreign debt.

South African companies were attracted to foreign sources of finance due to lower foreign interest rates. This chapter presents evidence that the advantage of lower foreign interest rates was offset by the cost of forward cover (the forward dollar premium), and therefore there was no benefit, after adjusting for risk, for South African management to borrow from offshore sources of finance.

The results of this study, in addition, indicate that the Reserve Bank has remained neutral in relation to influencing capital flows. The Reserve Bank has specifically not set the forward dollar premium

significantly below its interest parity value to encourage short-term capital inflows.

The study found that deviations from covered interest parity increased in the post-debt standstill period. However, except for limited specified periods, such deviations remained insignificant. These conclusions are however based on the interest data employed in the study.

In conclusion, the study was unable to reject the hypothesis that the foreign exchange market is efficient to the extent that covered interest arbitrage opportunities, except for a limited period, did not exceed related transaction costs. However, differences in political risk, capital controls and taxation are factors which would be expected to result in deviations from covered interest parity in the South African situation.

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CHAPTER 6

MARKET EFFICIENCY: TESTS ON THE RELATIONSHIP BETWEEN SPOT AND FORWARD EXCHANGE RATES*

OBJECTIVE

This chapter tests for market efficiency by examining the relationship between spot rates and forward rates. In an efficient market the forward rate should reflect market expectations of the future spot rate. Although the forward rate may not be a good predictor of the future spot rate, due to the effect of "news", it should be an unbiased predictor of the future spot rate (assuming a zero risk premium). Tests for market efficiency include plotting and regressing the spot rate against both the contemporaneous and corresponding forward rate. If spot and forward rates embody all current information and new information alters expectations regarding the future spot rate, then there should be a strong correlation between movements in the spot rate and movements in the contemporaneous forward rate. The addition of lagged forward rates to the equation should not result in coefficients which are significantly different from zero. The forward premium which reflects the expected change in the spot rate is plotted against actual changes in the spot rate. The validity of a zero risk premium in the pricing of forward exchange is tested by analysing the mean forward forecast error and related autocorrelations.

* The initial findings of part of this chapter were used in a paper presented at the Management and Economic Sciences Conference in 1987. Correia C. de J. "Foreign Exchange Management: Risk, Reserve Bank Policy, and the role of the Market in a changing Environment" Conference in Management and Economic Sciences, University of Natal, Pietermaritzburg, 20-22 October, 1987.

6.1 INTRODUCTION

The recent history of the South African foreign exchange market, reflecting a period of turbulence and the dramatic decline in the Rand exchange rate vis-a-vis the world's major currencies, has added impetus to the question of whether the foreign exchange market is efficient.

In Chapter 5, market efficiency was tested to the extent that covered interest arbitrage profit opportunities should be quickly eliminated. This involved testing for deviations from covered interest parity, which essentially represent risk-free profit opportunities.

Tests of market efficiency in relation to unexploited risk-adjusted profit opportunities are more problematic due to model specification problems and competing hypotheses. Market efficiency is a wide economic statement which requires the specification of testable hypotheses.

Chapters 6 and 7 will apply methodologies adopted from the market efficiency literature and apply new methods to test specific hypotheses. As there is no overall test of market efficiency, "tests of efficiency" should be measured against specific alternative hypotheses. In Chapter 5, we

tested the specific hypothesis that in an efficient market, deviations from covered interest parity should be quickly eliminated.

The market efficiency concept is expanded in chapters 6 and 7 by undertaking the following tests;

1. An analysis of the relationship between spot and forward exchange rates based on the assumption that the forward rate represents the market's expected future spot exchange rate.
2. Tests on the ability of traders/speculators to predict future exchange rate movements based on past rate movements (the so-called "weak-form" tests of market efficiency).
3. An analysis of the relationship between changes in the exchange rate and changes in "fundamental" variables which form part of the public information set (the so-called "semi-strong" tests of market efficiency).

6.2 THEORETICAL BACKGROUND

Fama (1970) defined an efficient market as one in which prices fully reflect available information. In an efficient market, prices adjust immediately to reflect new information. Therefore, currently available information cannot be employed to systematically predict future prices as such information has already been discounted in the asset price.

In contrast, an inefficient market implies that prices respond slowly to new information. This implies that traders/speculators can utilise new information to improve their accuracy in forecasting future exchange rate movements.

Expectations play a central role in the determination of the current exchange rate. New information which alters expectations is immediately reflected in changes to the current exchange rate.

Frenkel (1981, p.5) states;

"the modern approach to exchange rate determination implies that exchange rates are strongly influenced by "news", which by definition is unpredictable ... in periods which are dominated by "news" that alters expectations, exchange rates are likely to be more volatile."

The definition of an efficient market is of a general nature and requires the specification of empirically testable hypotheses.

Market efficiency is relevant in relation to specified information sets. Fama employed the terms weak form, semi-strong and strong form to describe the tests of market efficiency based on the information sets of past price movements, public information and all available information.

Formally, market efficiency requires that,

$$E (S_t - S_{e,t} | I_{t-1}) = 0 \quad (6.1)$$

Where $S_{e,t}$ is the one-period ahead forecast of the spot exchange rate based on the information set available at time $t-1$, I_{t-1} . E is the expectations operator. This implies that traders do not systematically make errors in setting forecasts of the future spot rate. If the error term consists of "white noise", then it contains no information which may be used to improve forecasts of future rates, and the market for foreign exchange market is said to be efficient.

6.3 FORWARD EXCHANGE RATES AND MARKET EFFICIENCY

In this section the forward exchange rate is used as a proxy to measure market expectations of the future spot rate. This is however subject to the assumption that there is a zero risk premium in the pricing of forward exchange. This limiting assumption is analysed further on in the study.

Forward exchange rates should reflect market expectations regarding future spot rates. This implies that the forward exchange rate is an unbiased predictor of the future spot exchange rate, otherwise traders may use any bias to devise profitable trading strategies and earn excess returns (assuming a zero risk premium). For instance, if the forward rate systematically under-predicted the future value of the rand spot exchange rate, traders could use this information to buy rands forward at time $t-1$ and sell Rands spot at the time of the exercise of the forward contract (time t).

Empirical studies (for example, see Frenkel 1981, Levich 1979[c]) which use forward rates to measure market efficiency, normally employ the following equation;

$$S_t = a + bF_{t-1} + u_t \quad (6.2)$$

Where S_t is the spot exchange rate at time t , F_{t-1} is the forward exchange rate ruling at time $t-1$ for delivery at time t and u_t is an error term.

If the foreign exchange market is efficient then the error term, u_t , should represent "white noise" and therefore should not be serially correlated. Market efficiency

requires that the forward exchange rate is an unbiased predictor of the future spot exchange rate. This means that in the above equation, the constant term, should not be significantly different from zero ($E(a)=0$) and the slope coefficient should not be significantly different from unity ($E(b)=1$).

Equation 6.2 is empirically tested for the South African rand/U.S. dollar exchange rate and the results are presented in Table 6.1.

6.4 DATA

As overlapping data induces serial correlation in the residuals, non-overlapping data was employed to test the equation using the rand/U.S. dollar spot and forward exchange rates for the one month and three month maturities.

Data was obtained directly from the International Division of Standard Bank in Johannesburg, and other data was downloaded from the Standard Bank's CATS system. The use of non-overlapping data reduces the sample size and means

that only the monthly spot and forward rates and three monthly spot and forward rates were used in order to obtain an acceptable sample size.

The data firstly consists of monthly end-of-the-month spot exchange rates and the one-month forward exchange rates for the period January 1981 to December 1985. This represents 59 observations. This period covered the introduction of the managed floating exchange rate system and abolition of the Financial rand system in 1983, the imposition of the debt standstill and the reintroduction of the financial rand system in August 1985.

In addition quarterly data was obtained for the period March 1981 to June 1989. This represents 33 observations. The data consists of end-of-quarter spot exchange rates and three month forward exchange rates.

Results of the OLS regression equation are presented in Table 6.1.

TABLE 6.1 **RESULTS OF REGRESSION EQUATION : $S_t = a + bF_{t-1} + u_t$**
(standard errors in parentheses)

<u>Coefficients</u>							
<u>Data</u>	<u>Period</u>	<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>	<u>h^*</u>
Monthly	1981.01- 1985.12	0.009 (0.015)	0.97 (0.017)	0.98	0.033	1.96	0.156
Quarterly	1981.1- 1989.2	0.043 (0.024)	0.91 (0.032)	0.96	0.052	1.76	0.712

The results for the monthly data are consistent with the market efficiency hypothesis. The constant is not significantly different from zero ($a=0.009$) and the slope coefficient is not significantly different from unity ($b=0.97$).

The R^2 is 98 percent indicating that the level of the forward exchange rate explains a high proportion of the changes in the level of the future spot exchange rate. The Durbin-Watson statistic of 1.96 is consistent with the absence of first order serial correlation in the error term.

The results for the quarterly data do not support the market efficiency hypothesis. The standard error of 0.024

* The Durbin-Watson statistic may not be appropriate for testing for serial correlation when there is a regression of a variable on its own lagged value. As F_{t-1} is highly correlated with S_{t-1} , Durbin's h statistic was calculated but this revealed an absence of serial correlation in the residuals at the 5 percent level of significance.

for the constant term indicates that the constant term is not significantly different from zero, at the 95 percent confidence level. However, the slope coefficient of 0.91 is significantly different from unity. The Durbin-Watson statistic of 1.76 is consistent with the absence of serial correlation in the error term.

6.5 LAGGED FORWARD EXCHANGE RATES

If the market is efficient, then the forward rate at time $t-1$ should include all available information including information implicit in the forward exchange rate at time $t-2$. This means that the addition of lagged forward exchange rates should not result in an improvement in the value of the R^2 ratio and should not result in coefficients that are significantly different from zero.

To empirically test this hypothesis, the forward exchange rate at time $t-2$, F_{t-2} , was added to equation 6.2 for both the monthly and the quarterly data. The results are presented in Table 6.2.

TABLE 6.2 RESULTS OF REGRESSION EQUATION :

$$S_t = a + b_1 F_{t-1} + b_2 F_{t-2} + u_t$$

(Standard errors in parentheses)

<u>Coefficients</u>							
<u>Data</u>	<u>Period</u>	\hat{a}	\hat{b}_1	\hat{b}_2	R^2	<u>s.e.</u>	<u>D.W.*</u>
Monthly	1981.01-	0.015	0.97	0.002	0.98	0.033	1.95
	1985.12	(0.016)	(0.136)	(0.136)			
Qtrly	1981.1-	0.043	1.01	-0.10	0.96	0.054	1.87
	1989.2	(0.026)	(0.183)	(0.169)			

In both cases, the addition of the lagged forward exchange rate, F_{t-2} , does not improve the goodness of fit as measured by the value of R^2 . Further, in both cases the coefficient of F_{t-2} is not significantly different from zero.

These results are consistent with the hypothesis of market efficiency, in that the forward exchange rate, F_{t-1} , includes all information including information implicit in the forward exchange rate quoted at time $t-2$.

* It is not possible to calculate Durbin's h statistic as $nV(b_1) > 1$. This represents a disadvantage to employing Durbin's h test. The test also applies only to large sample sizes.

6.6 THE FORWARD PREMIUM AND REALISED CHANGES IN THE SPOT EXCHANGE RATE

In an efficient market, exchange rates will respond immediately to new information which alters expectations about the future spot exchange rate. Therefore, as new information cannot be predicted, we would expect the forward exchange rate to be a poor predictor of the future spot exchange rate, although it may represent an unbiased predictor of the future spot exchange rate.

In Figures 6.1 and 6.2 the forward dollar premium/discount, which represents the expected change in the spot exchange rate, is plotted against the actual percentage change in the spot exchange rate, for the one-month and three-monthly data.

FIGURE 6.1 MONTHLY PERCENTAGE CHANGES IN THE SPOT RATE
AND THE ONE-MONTH FORWARD DOLLAR PREMIUM
JAN 1981 - DEC 1985

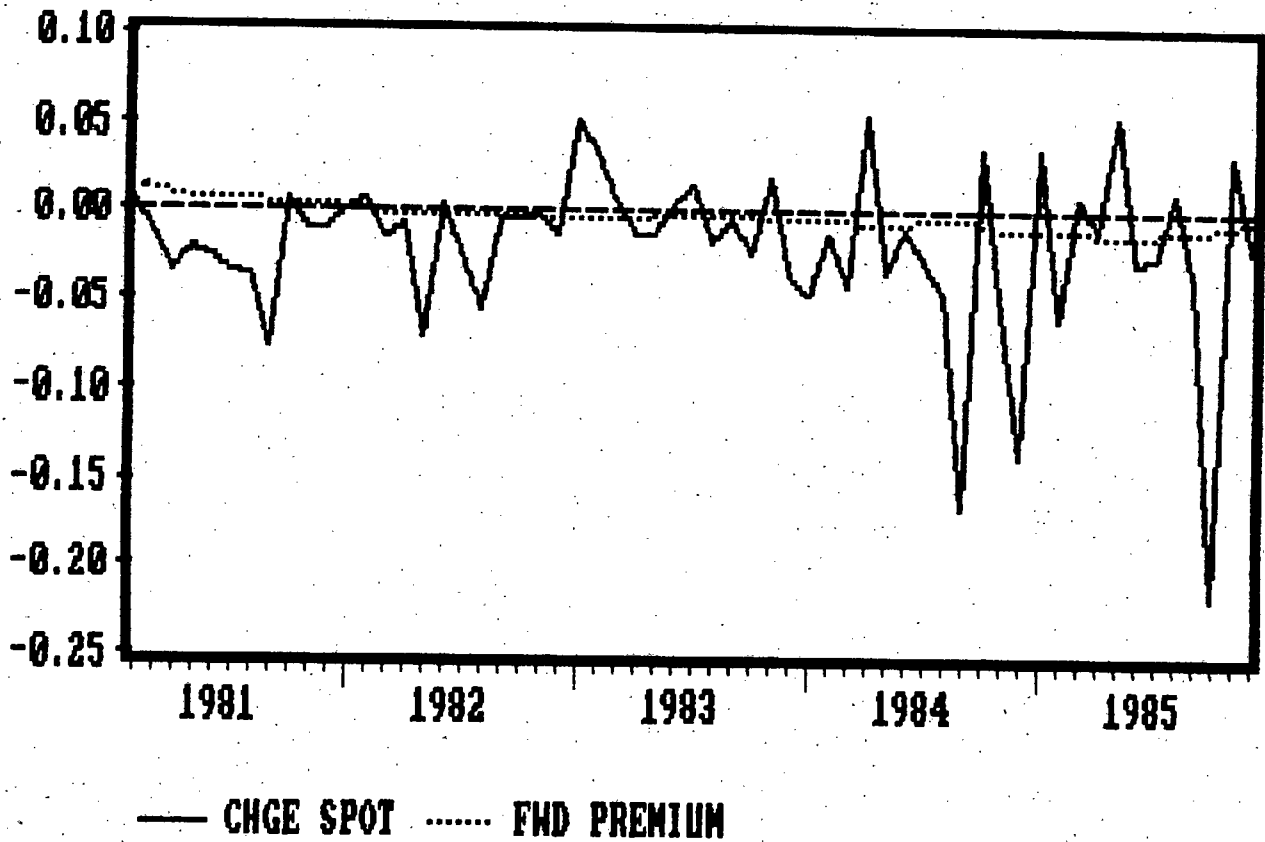
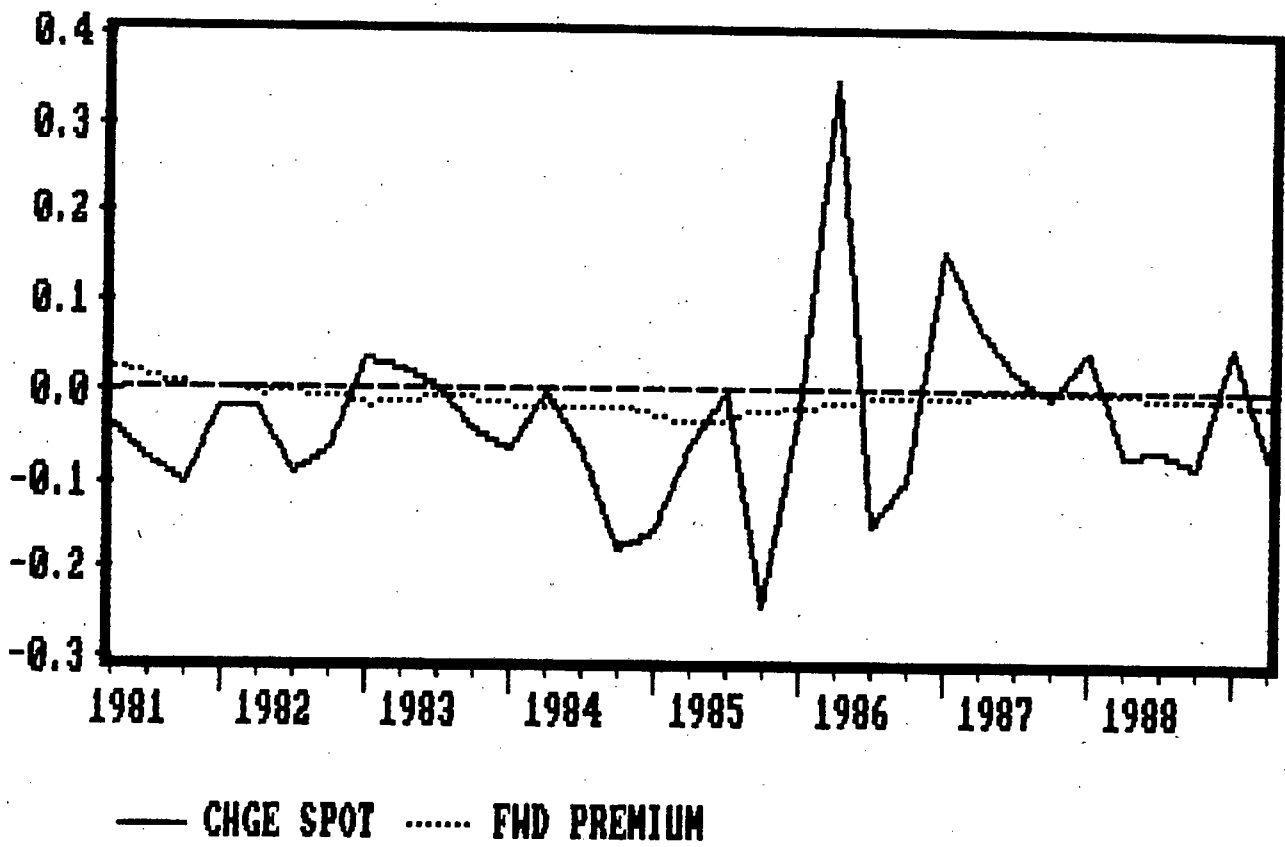


FIGURE 6.2 **THREE MONTHLY PERCENTAGE CHANGES IN THE SPOT
RATE AND THE THREE-MONTH FORWARD DOLLAR
PREMIUM**
JUNE 1981 - JUNE 1989



It will be noted from Figures 6.1 and 6.2 that generally, the forward premium has not been a useful predictor of the expected change in the spot exchange rate. Variation in the forward premium is insignificant in relation to the large movements experienced in the spot exchange rate over the sample period.

Frenkel (1981), who records similar empirical results, uses these results to conclude that most of the exchange rate changes are due to new information which by definition would not be reflected in the forward premium.

However, the large movements in the spot exchange rate and the relatively low forward premium may be indicative that the spot exchange rate is close to the market's best forecast of the future spot exchange rate, and the incremental benefit of the forward premium is low. However, the forward premium may be useful in predicting the direction of future exchange rate movements, as the U.S. dollar has been consistently at a forward premium (rand forward discount) since 1982 and the rand exchange rate has generally depreciated over this period.

6.7 THE SPOT EXCHANGE RATE AND THE CONTEMPORANEOUS FORWARD EXCHANGE RATE

The current spot exchange rate at time t , S_t , and the current forward rate, F_t , embody all information available at time t . New information which alters expectations about the future exchange rate should be immediately reflected in the spot exchange rate and the forward exchange rate. If this is so, then we would expect to find a high correlation between movements in the spot rate and movements in the contemporaneous forward exchange rate.

In Figure 6.3, the spot exchange rate at the end of each month is plotted against the contemporaneous monthly forward exchange rate for the period January 1981 to December 1985.

In Figure 6.4 the spot exchange rate at the end of each quarter is plotted against the contemporaneous three-month forward exchange rate for the period June 1981 to June 1989.

FIGURE 6.3 **THE SPOT RATE AND THE CONTEMPORANEOUS FORWARD RATE**

MONTHLY DATA : JAN 1981 - DEC 1985.

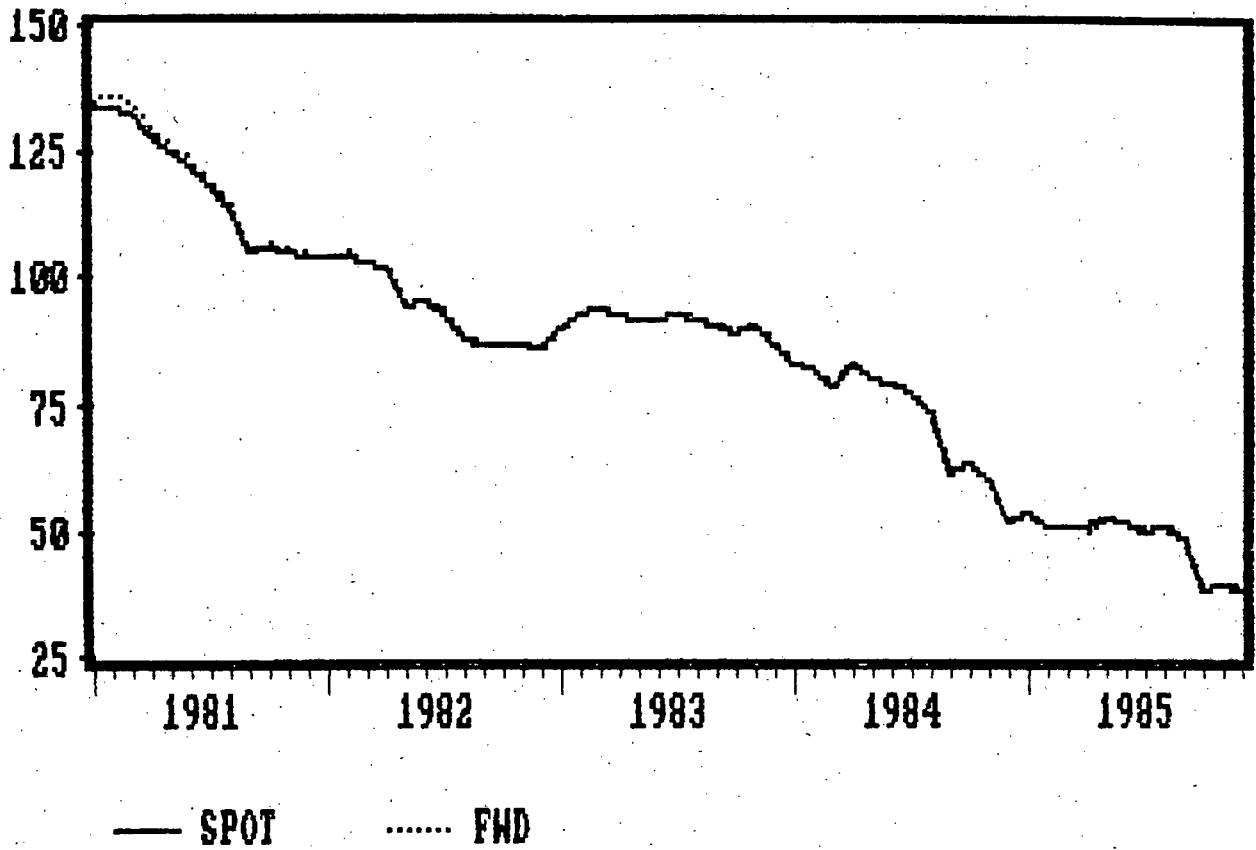
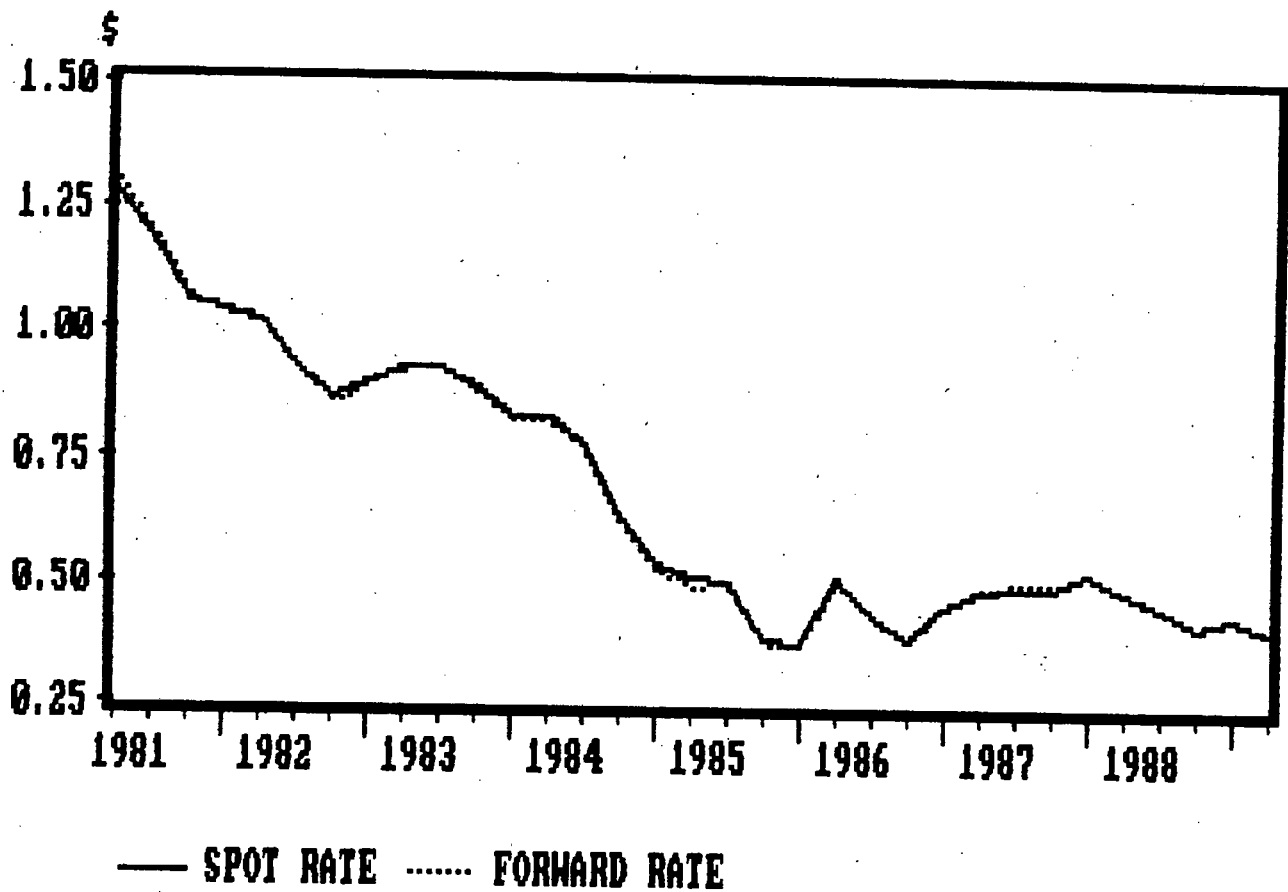


FIGURE 6.4 **THE SPOT RATE AND THE CONTEMPORANEOUS FORWARD RATE**

QUARTERLY DATA : JUNE 1981 - JUNE 1989



In both cases, the spot and forward exchange rates have moved extremely close together. If new information is driving exchange rates, then the spot rate and the contemporaneous forward rate appear to respond immediately and by the same amount to this new information (which by definition could not have been predicted).

The correlation between the percentage change in the spot rate and the percentage change in the forward rate for the monthly data, for the period January 1981 to December 1985 exceeds 99 percent, while the correlation between the percentage change in the spot rate and the percentage change in the forward rate for the quarterly data for the period June 1981 to June 1989, also exceeds 99 percent.

The high correlation between movements in the spot and the contemporaneous forward exchange rate is consistent with market efficiency. Figures 6.3 and 6.4 indicate that the spot and the contemporaneous forward exchange rate are very close to each other, and this may indicate that the market's best forecast of the future spot exchange rate is the current spot exchange rate.

This raises the question of whether any incremental benefit may be gained from using the forward rate rather than the current spot exchange rate to forecast the future spot exchange rate.

As previously mentioned, the forward dollar has generally been quoted at a forward premium (rand at a forward discount) and the rand has generally tended to depreciate over the period 1982-1989. Therefore, the forward rate may be useful to indicate the general future direction of the spot exchange rate. This finding is consistent with other studies (see, for example, Mussa, 1979).

If the forward exchange rate represents the market's optimal forecast of the future spot exchange rate, then the standard deviation of the errors of using the forward exchange rate should not exceed the standard deviation of the forecast errors in using any alternative model.

Table 6.3 presents summary statistics for the forecast errors of using the forward exchange rate and using the current spot exchange rate to predict the future spot exchange rate.

TABLE 6.3 SUMMARY STATISTICS OF FORECAST ERRORS :
RAND/U.S. DOLLAR RATE.

A. THE FORWARD RATE MINUS THE SUBSEQUENTLY OBSERVED SPOT RATE:
 $F_{t-1} - S_t$

<u>Data</u>	<u>Period</u>	<u>Mean</u>	<u>S.D.</u>	<u>t-statistic</u>
Monthly	1981.01- 1985.12	0.0138	0.0332	0.416
Quarterly	1981.1- 1989.2	0.0226	0.0586	0.386

B. THE SPOT RATE MINUS THE SUBSEQUENTLY OBSERVED SPOT RATE:
 $S_{t-1} - S_t$

<u>Data</u>	<u>Period</u>	<u>Mean</u>	<u>S.D.</u>	<u>t-statistic</u>
Monthly	1981.01- 1985.12	0.0161	0.0322	0.50
Quarterly	1981.1- 1989.2	0.0282	0.0572	0.493

In both cases the mean deviation is not significantly different from zero. Although the results are extremely close, the standard deviation of the forecast errors of using the forward rate slightly exceed the standard deviation of the forecast errors of using the current spot rate.

The mean deviation of the forecast errors in using the current spot rate slightly exceeds the mean deviation of the forecast errors in using the forward exchange rate. The spot exchange rate, based on the standard deviations, reflect very similar results to the forward exchange rate.

Prior evidence suggests that the forward rate is not a very good predictor of the future spot exchange rate, but may be an unbiased predictor of the future spot exchange rate. This is to be expected in an efficient market where the major determinant of exchange rate movements is new information which alters expectations regarding the future spot exchange rates.

However, market efficiency requires that the forward rate should generally be a better predictor of the future spot exchange rate than the current spot exchange rate. However, there are counterarguments to this hypothesis.

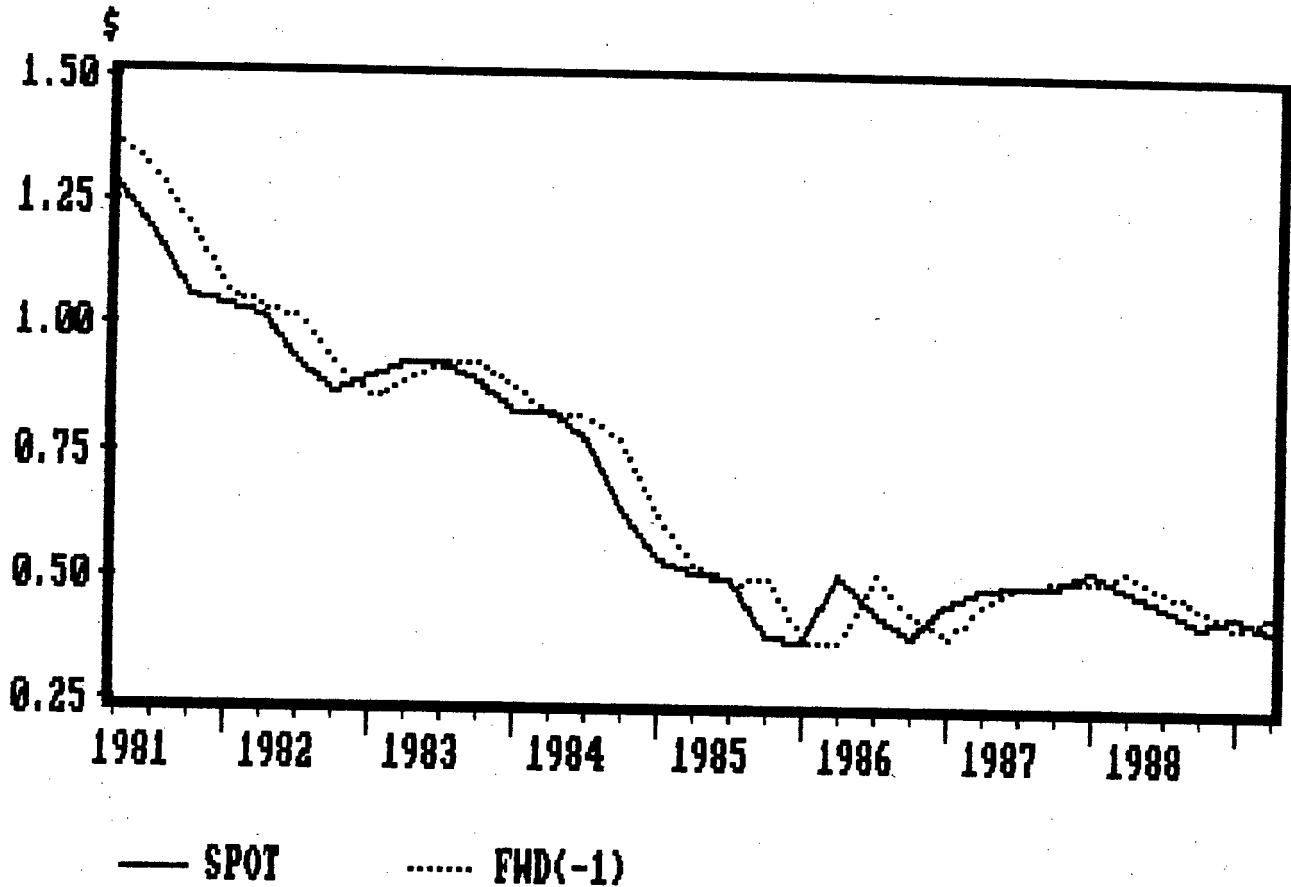
Longworth (1981, p.45) states;

"As the forward premium seems to have little to do with the change in the spot rates, perhaps the current spot rate itself is a better predictor of the future spot rate than is the forward rate. One cannot reject the hypothesis that the forward rate is an unbiased predictor of the future spot rate, but the more reasonable hypothesis might be that the current spot rate is an unbiased predictor of the future spot rate, and that the forward rate adds nothing."

In Figure 6.5 the current spot exchange rate, S_t , is plotted against the three month forward rate quoted at time $t-1$, F_{t-1} .

FIGURE 6.5 THE SPOT RATE AND THE CORRESPONDING FORWARD RATE

QUARTERLY DATA : JUNE 1981 - JUNE 1989.

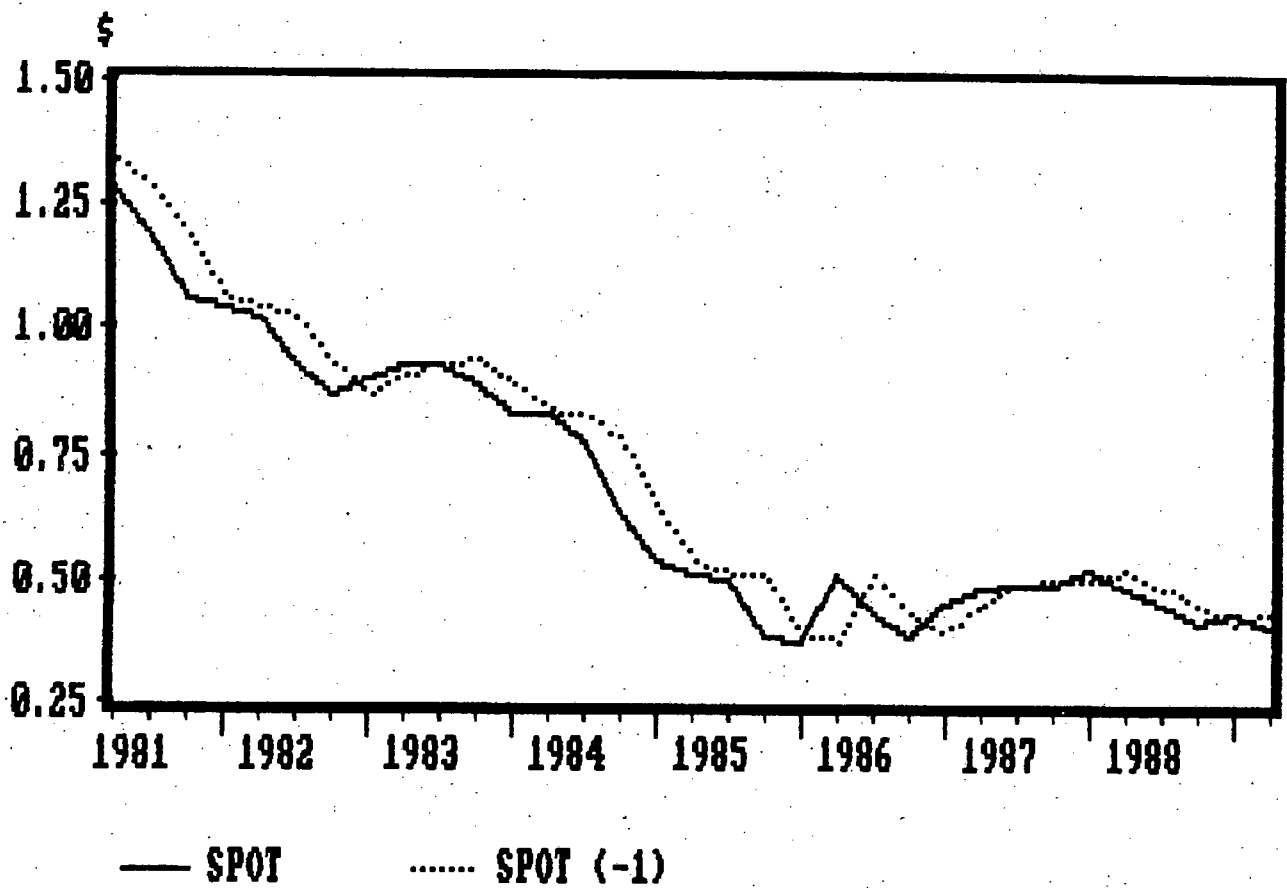


It is clear from Figure 6.5, that the forward rate was not able to predict the changes in the spot exchange rate over the sample period.

In Figure 6.6, the current spot rate, S_t , is plotted against the preceding spot exchange rate at time $t-1$, S_{t-1} .

The lagged spot exchange rate was not able to predict movements in the spot exchange rate.

FIGURE 6.6 THE CURRENT SPOT RATE AND THE LAGGED SPOT RATE
QUARTERLY DATA: JUNE 1981 - JUNE 1989



A comparison of Figures 6.5 and 6.6 indicates, that the lagged spot exchange rate was as good a predictor of the future spot rate as the forward exchange rate.

Crystal and Thornton (1988, p.324) state;

"Since the current spot rate embodies the same information as the current forward rate, it could dominate the forward rate as a predictor of the future spot rate. Indeed it is quite likely that the spot rate contains more information about future spot rates than the forward rate does, because the forward market is typically thinner and involves higher transaction costs".

However, the forward exchange rate may have a slight advantage to the lagged spot rate as a predictor of the future spot rate as the U.S. dollar has generally been quoted at a forward premium (the rand at a forward discount) in recent years, and the rand exchange rate has tended to depreciate over the same period.

However Crystal and Thornton (1988, p.328) state;

"We know that covered interest parity holds in Euro-deposit markets. If monetary authorities are able to peg interest rates, they will also influence the forward premium on currencies. Hence, the forward rate may be more affected by interest rate policy than by spot rate expectations".

In terms of the International Fisher effect, the relative interest differential should reflect expectations of the future movement in the spot exchange rate.

However, if the forward rate is a passive variable, as suggested by Crystal and Thornton, and merely reflects the interest differential between currencies and not the market's expectations of the future spot rate, then significant deviations between the quoted forward rate, which reflects covered interest parity, and the market's expected future spot rate would induce arbitrage (in a competitive market) so that the expected future spot rate and the quoted forward rate converge - even if this occurs through resultant pressures upon relative interest rates.

Market efficiency requires that the forward exchange rate should be an unbiased predictor of the future spot exchange rate. This assumes a zero risk premium in the pricing of forward exchange. This assumption is studied in the next section.

6.8 THE EXISTENCE OF A RISK PREMIUM IN FORWARD EXCHANGE

If the pricing of forward exchange includes a risk or liquidity premium, then the existence of bias in the forward exchange rate, is consistent with market efficiency. Cornell (1977, p.57) states:

"the average liquidity premium can be identified with the mean forecast error that occurs when the forward rate is used as a predictor of the future spot rate"

The results of tests undertaken by Cornell indicate that the average liquidity premium on forward exchange has been zero for the currencies examined in the study.

Levich (1979[c]) indicated that the mean forecast error for most currencies tested was not significantly different from zero. Frankel (1982) found that the mean forecast error for each of the six currencies tested was not significantly different from zero. The results of these studies suggest that there is a zero risk premium in the pricing of forward exchange.

The results of this thesis support the hypothesis of a zero risk premium. Tests of the regression equation, $S_t = a + bF_{t-1} + u_t$ indicate that the forward exchange rate is an unbiased predictor of the future spot exchange rate. Further, the mean forward forecast error reported in Table 6.3 was not significantly different from zero for both the monthly and quarterly data. If the risk premium is zero, then the forward exchange rate may be used to measure the market's expectation of the future spot exchange rate.

However, the results of these tests are also consistent with a risk premium that often changes sign but has a mean of zero. Frankel (1982) indicated that the forward forecast errors for certain currencies reflected serial correlation. Longworth (1981) and Cumby and Obstfeld (1981) reflect evidence which is consistent with the

existence of a risk premium, in that changes in the risk premium could result in serial correlation but a mean forward forecast error that is not significantly different from zero. To test for a time varying risk premium in forward exchange, the mean forward forecast error and the autocorrelations of the forward forecast errors are presented in Table 6.4.

TABLE 6.4 **AUTOCORRELATIONS OF THE FORWARD FORECAST ERRORS**

Data Period	Monthly 1981.02- 1985.12	Quarterly 1981.1- 1989.2
No. of obs.	59	33
Mean	0.0138	0.018
p_1	0.03	0.22
p_2	0.12	-0.22
p_3	0.21	0.24
p_4	0.03	0.31
p_5	-0.11	-0.11
p_6	-0.05	-0.33
p_7	-0.06	-0.06
p_8	-0.05	0.08
S.E.	0.13	0.17

In terms of the monthly spot and one-month forward rates, the mean forecast error is not significantly different from zero. This is consistent with the hypothesis that the average risk premium is zero. Further, the autocorrelations are not significant and this reflects evidence against the existence of a time varying risk premium which is on average equal to zero.

The mean of the quarterly forward forecast errors is also not significantly different from zero. Although the autocorrelation coefficients are much larger than for the monthly data, they are still not statistically significant at the 95 percent confidence level.

In general, the study was not able to establish the existence of a risk premium in the pricing of forward exchange. This indicates that the forward rate should reflect the market's expectations of the future spot exchange rate.

In an efficient market the forward rate should be an unbiased predictor of the future spot exchange rate. The results of this study support this hypothesis.

6.9 CONCLUSION

The results of the tests performed on forward rates are generally consistent with the concept of market efficiency. Firstly, the forward rate was found to be an unbiased predictor of the future spot exchange rate. If there is no risk premium in the pricing of forward exchange, then market efficiency requires that the forward rate should be an unbiased predictor of the future spot rate.

Secondly, the addition of further lagged forward exchange rates to the regression equation did not result in an improvement in the goodness of fit nor in coefficients which were significantly different from zero. This is consistent with the hypothesis that forward rate should reflect all information including the information implicit in lagged forward exchange rates.

Thirdly, if in an efficient market the driving force behind exchange rate movements is new information, then the forward premium should not be a good predictor of future movements in the spot exchange rate. The empirical evidence is consistent with this hypothesis.

Fourthly, the current spot exchange rate and the contemporaneous forward exchange rate appear to be based on the same information set available at time t . If the major determinant of exchange rate movements is new information which alters expectations, then in an efficient market there should be a high correlation between movements in the spot exchange rate and movements in the contemporaneous forward exchange rate. Again, the empirical evidence is consistent with the efficient market hypothesis.

Although this represents convincing evidence in support of the efficiency of the forward exchange market, there remain unfortunately a few persistent doubts. Firstly, evidence indicates that the current spot rate may be as good a predictor of the future spot rate as the corresponding forward rate.

Secondly, although the forward rate reflects covered interest parity, it may be a passive variable. The market for interest securities may reflect inefficiencies, and yet the forward rate may still be correctly priced to reflect covered interest parity, but not the market's expectation of the future spot exchange rate.

In an open economy, arbitrage transactions should result in a convergence of a forward rate that reflects the future expected spot rate and a forward rate that reflects covered interest parity.

If the expected future and spot exchange rate is systematically below the quoted forward rate, which reflects covered interest parity, then traders will purchase foreign currency forward and sell foreign currency spot when the forward contracts mature.

If traders proceeded with these transactions, this would result in banks covering positions by undertaking current borrowings from local sources, purchasing foreign currency on the spot market and investing in foreign interest securities until the maturity date of the forward contracts.

This would result in a decline in foreign interest rates and an increase in local interest rates. There would be an increase in the forward and discount in order that the forward rate reflects covered interest parity.

These transactions result in relative interest rates reflecting the market's expectation of the future spot exchange rate. By definition, in such a situation if the forward rate reflects covered interest parity, it also reflects the market's expectation of the future spot exchange rate.

However, if the market for interest securities is subject to stringent controls which preclude these arbitrage transactions, and exchange control preclude arbitrage transactions between the spot and forward markets, then the authorities may simulate an efficient market with respect to the pricing of forward exchange, in that it reflects covered interest parity, but does not reflect the expected future spot rate.

This implies that although the pricing of forward exchange may be efficient (in the sense that it reflects covered interest parity), the market for interest securities and the spot market may be inefficient.

The large losses incurred by the Reserve Bank on its forward exchange account may indicate that although the forward rate reflects covered interest parity, it does not

reflect the expected future spot exchange rate, and traders are experiencing a "one way bet" with the Reserve Bank/Treasury.

In South Africa, the Reserve Bank sets the price of forward exchange. The inability of the Reserve Bank to withdraw from this market as planned, was due to the restrictions of the exchange control regulations on banks to cover forward purchases of foreign currency by clients. Without exchange control this would normally occur through the purchase of foreign currency spot and the investment in foreign interest securities to maturity date.

The pricing of forward exchange may preclude the earning of risk-free profits from covered interest arbitrage. Speculation may result in excess profits - however, the absence of bias in the pricing of forward exchange may refute this argument.

In conclusion, subject to the above caveats, the tests on the relationship between spot and forward rates generally lend support to the efficient market hypothesis. The time series behaviour of the spot rate and forward rate is generally consistent with market efficiency and the results

of the tests are consistent with the efficient pricing of forward exchange. In the next chapter tests are performed to measure the efficiency of the pricing of spot exchange rates.

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CHAPTER 7

SPOT EXCHANGE RATES AND MARKET EFFICIENCY

OBJECTIVE

The objective of this chapter is to examine the efficiency of the spot foreign exchange market. The methodologies adopted to test for "weak form" efficiency involve tests for serial correlation and analysing the profitability of filter trading rules relative to a buy-and-hold policy. Tests of "semi-strong" efficiency involve tests of the forecasting ability of an advisory service relative to the forward rate, and an empirical analysis of the relationship between the spot exchange rate and publicly available information on selected macro-economic variables. If the foreign exchange market is efficient then traders should not be able to use past movements in the spot exchange rate, and publicly available information on macro-economic variables to systematically improve their forecasts of the future spot exchange rate.

7.1 INTRODUCTION

In the previous chapter, tests were applied to measure the efficiency of the forward exchange market. Generally, the tests were unable to reject the hypothesis that the forward exchange market is efficient, and there were several indications that the current spot rate was as good as the forward exchange rate in predicting the future spot exchange rate.

In this chapter, tests are applied to measure the efficiency of the spot exchange market. Market efficiency requires that the current spot exchange rate reflects all available information at the current date. A sub-set of all available information represents the past history of spot exchange rates.

If the market is efficient, then traders/speculators should not be able to systematically earn excess returns by forecasting the future spot exchange rate on the basis of past movements in the spot exchange rate. If the equilibrium return remains constant then the market is efficient if the spot exchange rate follows a random walk.

One of the tests undertaken in Chapter 6 on forward market exchange rates, involved regressing the spot rate at time t on the forward rate at $t-1$ for delivery of foreign currency at time t . The results of this test indicated that the forward rate was an unbiased predictor of the future spot exchange rate, which is what would be expected to occur in an efficient market (assuming a zero risk premium).

In this chapter, the following equation is used to test the relationship between the spot rate and the lagged spot exchange rate:

$$S_t = a + bS_{t-1} + u_t \quad (7.1)$$

Where S_t is the current exchange rate, S_{t-1} is the lagged spot rate at time $t-1$ and u_t is the error term. The above formula represents the familiar "random walk" model.

This equation has been used to test market efficiency (see, for example, Chrystal and Thornton, 1988), in that if the spot exchange rate reflects all information, then the current spot rate should include all information implicit in the past history of exchange rates. Therefore, past movements in the spot exchange rate will have no value for forecasting future movements in the spot exchange rate.

The current spot exchange rate reflects all information implicit in past exchange rates.

If the market is weak form efficient then the expected value of the constant, [a], should be zero and the slope coefficient, [b], should not be significantly different from unity. Most importantly, the error term should reflect the absence of first order autocorrelation.

Equation 7.1 was tested firstly for the period January 1981 to December 1985 on a monthly data basis, and for the period June 1981 to June 1989 on a quarterly data basis. The sample periods correspond to the periods examined in regressing the current spot rate on the corresponding forward rate as reflected in equation 6.2 in Chapter 6. The results are presented in Table 7.1.

In addition, the data source was expanded and the regression equation was applied to monthly data over the 10 year period, June 1979 to May 1989. These results are also presented in Table 7.1.

TABLE 7.1

RESULTS OF REGRESSION EQUATION: $S_t = a + bS_{t-1} + u_t$
(standard errors in parentheses)

<u>Coefficients</u>							
<u>Data</u>	<u>Period</u>	<u>\hat{a}</u>	<u>\hat{b}</u>	<u>s.e.</u>	<u>R^2</u>	<u>D.W.</u>	<u>h^*</u>
Monthly	1981.01- 1985.12	-0.007 (0.015)	0.99 (0.017)	0.032	0.98	2.05	-0.195
Quarterly	1981.1- 1989.2	0.03 (0.025)	0.918 (0.033)	0.053	0.96	1.76	0.713
Monthly	1979.06- 1989.05	-0.003 (0.007)	0.996 (0.008)	0.029	0.99	1.76	1.320
Monthly	1986.01 1989.05	0.064 (0.042)	0.856 (0.092)	0.024	0.69	1.58	1.664

The results of the regression equation tested in Table 7-1 are consistent with the efficient market hypothesis. The constant, [a], is not significantly different from zero for all three data sets (at the 5% level). The estimate of the slope coefficient [b] is not significantly different from unity. The Durbin-Watson statistic indicates the absence of first order serial correlation.

If the foreign exchange market is efficient, then spot exchange rates should adjust immediately to reflect any new information which alters expectations. If the spot exchange rate adjusts immediately, then this implies that

* The calculation of Durbin's h statistic does not reveal the existence of positive serial correlation at the 5 percent level of significance.

future exchange rates can not be predicted on the basis of past exchange rates.

The random behaviour of the spot exchange rate is consistent with market efficiency in that traders/speculators were not able to use past movements in the spot exchange rate to systematically predict the future spot exchange rate.

In Table 6.3 in Chapter 6 the mean of the spot rate minus the subsequently observed spot rate, $S_{t-1} - S_t$, was found to be not significantly different from zero. The mean deviation for the new monthly data for the period June 1979 to May 1989 is -0.007, with a standard deviation of 0.029.

This mean deviation for the new monthly data is also not significantly different from zero. These results are consistent with an efficient market as exchange rate movements appear to be random.

7.2 AUTOCORRELATION TESTS ON SPOT EXCHANGE RATES

The tests for serial correlation are expanded by analysing the autocorrelation function for a number of currencies and time periods.

Firstly, the autocorrelation function was estimated for monthly returns on spot exchange contracts for the period June 1979 to May 1989 for the Rand/U.S. dollar spot exchange rate. The autocorrelation coefficients for up to eight lags are presented in Table 7.2.

**TABLE 7.2 AUTOCORRELATION COEFFICIENTS
MONTHLY RAND/U.S. DOLLAR SPOT RATES**

Period	1979.06-1989.05
No. of obs	119
p_1	0.060
p_2	0.113
p_3	0.055
p_4	-0.098
p_5	-0.181*
p_6	-0.210*
p_7	0.183*
p_8	-0.020
S.E.	0.091

* Statistically significant at 5% level

In respect to the eight lags, it was found that the autocorrelation coefficients for three lags were statistically significant, although for lags 5 and 7 only marginally so.

Higher order autocorrelation is inconsistent with market efficiency as it indicates that lagged returns in the spot market may be used to predict future returns.

The autocorrelation function was also estimated for one-day rates of return for the U.S. dollar, sterling and deutschemark currencies for the period November 1988 to June 1989. The autocorrelation coefficients are presented in Table 7.3.

Only five estimates are statistically significant at the 95 percent confidence level. However, all three currencies indicate significant first order autocorrelation. This implies that traders/speculators are able to use the immediately preceding one day return to predict the next day's spot exchange rate return. The use of past returns to predict future returns is inconsistent with the efficient market hypothesis.

TABLE 7.3 **AUTOCORRELATION COEFFICIENTS**
DAILY SPOT RAND EXCHANGE RATES:
NOVEMBER 1988 - JUNE 1989

<u>Currency</u>	<u>US Dollar</u>	<u>UK Sterling</u>	<u>Deutschemark</u>
Period	21.11.88- 30.06.89	15.11.88- 26.06.89	21.11.88- 30.06.89
No. of obs	159	159	159
p_1	-0.228*	-0.180*	-0.209*
p_2	0.201*	-0.031	0.119
p_3	-0.128	-0.048	0.021
p_4	0.134	0.149	0.006
p_5	-0.042	-0.090	0.013
p_6	0.007	-0.109	-0.100
p_7	0.029	0.066	-0.047
p_8	-0.256*	-0.082	0.043
S.E.	0.079	0.079	0.079

* Statistically significant at 5% level.

The autocorrelation function was further estimated for weekly returns for the rand/U.S. dollar, rand/sterling and rand/lira spot exchange rates for the period July 1986 to June 1989. The autocorrelation coefficients are presented in Table 7.4.

TABLE 7.4 **AUTOCORRELATION COEFFICIENTS**
WEEKLY SPOT RAND EXCHANGE RATES.

<u>Currency</u>	<u>UK Sterling</u>	<u>Lira</u>	<u>US Dollar</u>
<u>Period</u>	<u>July 1986 - June 1989</u>	<u>July 1986 - June 1989</u>	<u>Aug. 1983 - Feb. 1988</u>
No.of obs	159	159	232
p ₁	0.036	0.004	0.073
p ₂	0.065	-0.018	0.101
p ₃	0.033	-0.023	-0.155*
p ₄	-0.048	-0.114	-0.073
p ₅	0.060	-0.038	0.050
p ₆	-0.018	-0.096	0.095
p ₇	-0.048	-0.095	0.060
p ₈	0.034	-0.057	0.003
S.E.	0.079	0.079	0.066

* Statistically significant at the 5% level.

The autocorrelation coefficients for the weekly returns on spot exchange rates are not (except for one) statistically significant at the 95 percent confidence level. The autocorrelations indicate that there are no linear trends in weekly spot exchange rates. In general, the autocorrelation coefficients indicate that spot exchange rate movements are random and there are no linear trends in

the spot exchange rates for various currencies over various time periods.

However, the significant first order autocorrelations recorded for the daily spot exchange rates for sterling, the U.S. dollar and the deutschemark indicate that the daily returns on spot exchange contracts may be useful to improve forecasts of the next day's returns. This is not consistent with the efficient market hypothesis.

Of course, serial correlation tests, although often used in market efficiency tests, may suffer from certain weaknesses. Cornell and Dietrich (1978, p.115) state;

"If the stochastic process generating daily exchange rates is non-stationary, the autocorrelation function may fail to detect the underlying pattern"

One way to increase the confidence in the results of the serial correlation tests is to test the profitability of technical trading rules. A commonly used technique relates to using filter rules to test for possible "bandwagon effects".

7.3 FILTER TRADING RULES

Filter trading rules were traditionally used to test for weak-form efficiency in the stock market. Logue and Sweeney (1977, p.764) quote one rule tested as; "Buy when the price is X% above its previous low and sell when the price is Y% below its previous high".

In relation to the foreign exchange market, the rule states; when a foreign currency appreciates X% from a previous low, purchase foreign currency and sell local currency; when the foreign currency depreciates Y% from a previous high, sell foreign currency and repurchase local currency. Filter trading rules are designed to enable traders to take advantage of discernible "market trends".

The profits earned from using a filter trading rule are compared to a buy-and-hold policy. The study takes the view of a South African trader who determines returns in rands. The adoption of a simple buy-and-hold policy implies that a trader will buy foreign currency with rands on the first day and sell foreign currency for rands on the last day. In contrast, by following the filter trading rule the trader will buy into a "rising market" and sell out of a

"falling market" during the sample period. It is assumed the investor will hold either rands or foreign currency.

Logue and Sweeney (1977) and Cornell and Dietrich (1978), in testing for autocorrelation, found that exchange rate changes represented "white noise" and concluded that this was consistent with market efficiency. However, the use of filter trading rules resulted in significantly greater returns than employing simple buy-and-hold policies.

If the foreign exchange market is efficient, then a filter trading rule should not result in significantly higher returns than a simple buy-and-hold policy. This would contradict the "chartist" view that there are discernible market trends which can be used to forecast future exchange rates.

There are numerous possible permutations in selecting the X and Y filters. The filters used in this study range from 0.2 percent to 5 percent. The X and Y filters were set at equal values in each case. A number of filter trading rules were applied to the monthly spot rand/U.S. dollar exchange rates for the period June 1979 to May 1989.

The trader is assumed to start with R100 which is used to purchase foreign currency on the first day.

If the trader applies a filter rule, then the foreign currency will be sold for rands as soon as its value falls by at least a given percentage against rands. If the foreign currency rises by at least the filter percentage, then funds are switched from Rands into foreign currency. If there are dependencies in price changes, as chartists often claim, which are useful to predict future movements in exchange rates, then applying a filter trading strategy would result in a higher return than a simple buy-and-hold policy.

In a buy-and-hold policy, the trader purchases the foreign currency on the first day and sells the foreign currency on the last day of the period studied. The results of applying various the filter tests are presented in Table 7.5.

In relation to interest returns earned on securities quoted in each currency Cornell and Dietrich (1978 : p.115) adopted the methodology of adjusting for interest earned at the end "by multiplying the average interest rate in each

currency by the fraction of time the investor was in that currency"

Due to an overdue reliance on average interest rates over a lengthy sample period, this methodology may result in inaccurate results. In this thesis the interest adjustment is based on the average interest rate for each specific period that traders remained in each currency.

Although this method necessitated a large number of computations for the smaller filters, it would be more sympathetic to the theory that relative interest rates compensate on average for currency movements.

For example, this method would take into account a situation where a trader was in a currency which was depreciating, yet was at the same time gaining (on average) from the higher interest rates being paid on securities denominated in the depreciating currency.

The interest rates employed reflect the monthly prime overdraft interest rates quoted in South Africa and the United States over the sample period. In general, South Africa registered higher nominal interest rates over the

sample period. The thesis assumes that traders are able to achieve a return equal to the prime overdraft rates quoted in each currency.

If we compare a buy-and-hold policy to various filter trading rules, Table 7.5 indicates that the filter trading rules were not able to outperform a simple buy-and-hold policy. This is consistent with market efficiency.

However, once an adjustment is made for interest returns earned on securities quoted in each currency, then the one and two percent filter trading rules outperform a simple buy-and-hold policy. The five percent filter trading rule still results in a weak trading strategy.

Although, the interest adjusted results for the one and two percent filter trading rules appear to outperform a simple buy-and-hold policy, a further adjustment is made for transaction costs.

In Table 7.5 the results are further adjusted for an estimated minimum transaction cost of 0.1 percent. At an exchange rate of U.S. \$0.50 this represents a transaction cost of 5 exchange rate points per transaction. This

estimate covers half the spread on the foreign exchange market assuming traders are achieving interbank bid-ask spreads.

The actual transaction costs of maintaining a filter trading rule in terms of management time, administration costs and control is significantly higher than the estimate used. Further, transaction costs would be incurred in relation to administration and fee costs of maintaining bank accounts in the quoted currencies.

Once the results for the one and two percent filters are adjusted for the minimum level of transaction costs incurred, then the terminal values of using the one and two percent trading rules become very close to the results of using a simple buy-and-hold policy.

This is consistent with market efficiency, which states that filter trading rules should not outperform a simple buy-and-hold policy.

TABLE 7.5**FILTER TRADING RULE RESULTS****MONTHLY RAND/U.S. DOLLAR SPOT EXCHANGE RATES:****JUNE 1979 - MAY 1989.**

<u>Filter Size</u>	<u>No. of Trades</u>	<u>Terminal Value</u> <u>1</u>	<u>Terminal Value</u> <u>2</u>	<u>Terminal Value</u> <u>3</u>
1%	36	R281.30	R1 033.40	R921.43
2%	28	259.80	947.20	923.95
5%	10	151.57	497.53	-
Buy-and-Hold	2	R301.48	R931.92	R923.41

1 = (No interest adjustment)

2 = (Interest adjusted)

3 = (Adjusted for interest and transaction costs)

The results in Table 7.5 indicate that filter trading rules were not able to outperform a simple buy-and-hold strategy. This indicates that the exchange rate fluctuated randomly around a trend - which over the sample period, reflected a long term decline in the Rand/U.S. dollar spot exchange rate.

The inability of filter rules to outperform a simple buy-and-hold policy is consistent with the efficient market hypothesis, in that, traders were unable to use past movements in the spot exchange rate to predict future

movements in the spot exchange rate and were thereby unable to systematically earn a higher return than that achieved under a simple buy-and-hold policy.

Further filter trading rules were applied to other data sets for three currencies. Filter trading rules were applied to the daily spot exchange rate for sterling, the U.S. dollar and the deutschemark.

In this case due to the use of daily data over 7 months the interest adjustment was determined by using the average interest rate per currency and the proportion that a trader remained in each currency during the sample period.

The filters used in this case were 0.1 percent, 0.2 percent and 0.5 percent. The results of using filter trading rules on daily exchange rates are presented in Table 7.6.

TABLE 7.6

FILTER TRADING RULE RESULTS

DAILY EXCHANGE RATES

NOVEMBER 1988 - JUNE 1989.

<u>A. Currency:</u>	<u>U.K. Sterling</u>	15.11.88 - 26.06.89	
<u>Filter Size</u>	<u>No. of Trades</u>	<u>Terminal Value</u> (no interest adjustment) <u>R</u>	<u>Terminal Value</u> (interest adjusted) <u>R</u>
0.2%	68	93.71	102.45
0.5%	20	94.98	103.47
1.0%	10	92.40	100.24
Buy-and-Hold	2	R99.07	R106.69

<u>B. Currency:</u>		<u>Deutschemark</u>	21.11.88 - 30-.06.89	
<u>Filter Size</u>	<u>No. of Trades</u>	<u>Terminal Value</u> (no interest adjustment) <u>R</u>	<u>Terminal Value</u> (interest adjusted) <u>R</u>	
0.2%	42	103.18	110.17	
0.5%	18	101.58	107.82	
1.0%	8	99.35	105.45	
Buy-and-Hold	2	R103.55	R107.67	

C. Currency: U.S. Dollar 21.11.88 - 30.06.89

<u>Filter Size</u>	<u>No. of Trades</u>	<u>Terminal Value</u> (no interest adjustment) <u>R</u>	<u>Terminal Value</u> (interest adjusted) <u>R</u>
0.2%	50	105.06	113.58
0.5%	28	104.47	112.75
1.0%	12	107.56	115.50
Buy-and-Hold	2	117.58	125.15

Tests on the profitability of using filter trading rules on daily rates for the three currencies tested, result in similar conclusions as those reached in the study of the monthly rates. No filter trading rule for U.K. sterling, the deutschemark and the U.S. dollar (ignoring interest returns) outperformed a simple buy-and-hold policy.

The adjustment for interest returns on invested securities, employing the prime overdraft interest rates in each currency to measure returns, does not alter the results for sterling and the U.S. dollar, that is, no filter trading rule outperforms a buy-and-hold policy. In respect to the deutschemark, the 0.2 and 0.5 percent filters result in

small profits in relation to a simple buy-and-hold policy, however, the size of these profits are not sufficient to offset related transaction costs.

In conclusion, the results of the filter trading rule tests are consistent with market efficiency. Filter trading rules have not outperformed a simple buy-and-hold policy. This conclusion is subject to the usual caveat that the results are valid for the sample period and the filter sizes and currencies selected. However, the results support the autocorrelation tests performed in the prior section.

This is in contrast to studies by Cornell and Dietrich (1978) and Logue and Sweeney (1977) who reported an absence of serial correlation in terms of the normal autocorrelation tests but found that filter trading rules resulted in excess returns.

The results in this study lend support to the efficient market hypothesis in that the use of past movements in the exchange rate are not useful in predicting movements in the future spot rate. This implies that the "chartist"

approach to forecasting future movements in the spot exchange rate lacks empirical support.

Table 7.6 indicates that for daily returns on spot exchange contracts, filter trading rules were not able to outperform a simple buy-and-hold policy. The filter trading results are consistent with the concept of market efficiency. If the market is efficient, then filter trading rules should not outperform a simple buy-and-hold policy.

Although a few autocorrelations were significant in the serial correlation tests, the filter tests indicate that in general, the market is efficient to the extent that over the sample periods there were few dependencies to be found in spot exchange rate movements.

These results are perhaps surprising, considering the extensive system of exchange controls in South Africa and the possible influence of the Reserve Bank over rand exchange rate movements, however, the time series properties of the rand spot exchange rate over the sample period are consistent with weak-form market efficiency.

7.4 FURTHER TESTS OF MARKET EFFICIENCY

7.4.1 INTRODUCTION

The focus of this thesis was to test the efficiency of the foreign exchange market by firstly, testing for the existence of covered interest arbitrage opportunities, secondly, by undertaking an empirical analysis of the relationship between spot and forward exchange rates and thirdly, by undertaking an empirical study of the time series properties of movements in the rand spot exchange rate.

In this section, tests on market efficiency are expanded to include an analysis of the relationship between the Commercial rand exchange rate and certain "fundamental" variables and an analysis and empirical testing of the accuracy of a forecasting organisation.

In the previous section, tests of market efficiency were based on the information set of historical exchange rates. The various tests were unable to reject market efficiency,

to the extent that traders are not able to use past movements in spot exchange rates to earn excess returns.

The tests in this section may indicate whether the foreign exchange market achieves semi-strong efficiency in relation to the variables tested. The tests in Chapter 6, also reflected tests of semi-strong efficiency. If the market is semi-strong efficient, then the spot exchange rate should reflect the public information set. The forward rate is part of the public information set.

The first test in this section is to measure the forecasting accuracy of a foreign exchange advisory service. The study then analyses the relationship between the spot exchange rate and five variables; the gold price, foreign exchange reserves, money supply growth, the current account balance and the Financial rand rate. The validity of the purchasing power parity theory in South Africa has been studied elsewhere.¹

The objective of the thesis is not to test models of exchange rate determination. Rather, the objective is to test whether publicly available information on certain

1 See Holden M. (1986) A Note on Purchasing Power Parity in South Africa. South African Journal of Economics, Vol 54 No. 3 p.332-338

variables could be used to devise trading rules that earn significant returns.

The variables selected are important for a number of reasons. The gold price is a critical variable for South Africa's economy and its balance of payments and as a source of government revenue. The authorities may be inclined to protect the rand price of gold to protect the mining industry and its substantial mining tax revenues.

The monetary model of exchange rate determination emphasises the role of national money supplies.

Chapters 2 and 3, recorded numerous occasions when the authorities (prior to the managed float era) referred to the state of the Reserve Bank's foreign exchange reserves to justify a change in the exchange rate.

The Financial rand exchange rate may reflect the market's expectations of the future direction of the Commercial rand spot exchange rate.

The objective in testing the relationship between the spot exchange rate (i.e. the Commercial rand) and these

variables is to establish firstly, whether a statistically significant relationship exists, but more importantly to determine whether the utilisation of public information on these selected variables may lead to improved forecasts of future spot exchange rates.

The study first analyses the forecasting accuracy of a foreign exchange advisory service.

7.4.2 TESTS ON THE FORECASTING ACCURACY OF AN ADVISORY SERVICE

In this section, a test of market efficiency is devised by analysing the forecasting accuracy of the Standard Bank's foreign exchange advisory service. The Standard Bank provides quarterly forecasts of the future spot rand/U.S. dollar exchange rate.

If the market is efficient and the spot exchange rate reflects all public information, then the mean squared forecast error of using the Standard Bank estimates should not be significantly less than the mean squared forecast

error of using the forward rate and/or the current spot rate to estimate the future spot rate.

It may be argued that this represents a test of strong form efficiency, in that Standard Bank with First National Bank are the major participants and dealers in the South African foreign exchange market. Therefore, Standard Bank should be in a position to obtain privileged or "inside" information about future exchange rate movements.

Quarterly data for the period June 1981 - June 1989, was obtained from the Standard Bank CATS system. The quarterly forecasts are revised at the end of each month, therefore the final quoted forecasts represent the last month of the preceding quarter's forecast.²

Forecast errors are calculated as follows;

$$E_{t-1} = [(S_t - S_{f,t-1})/S_t]^2 \quad (7.2)$$

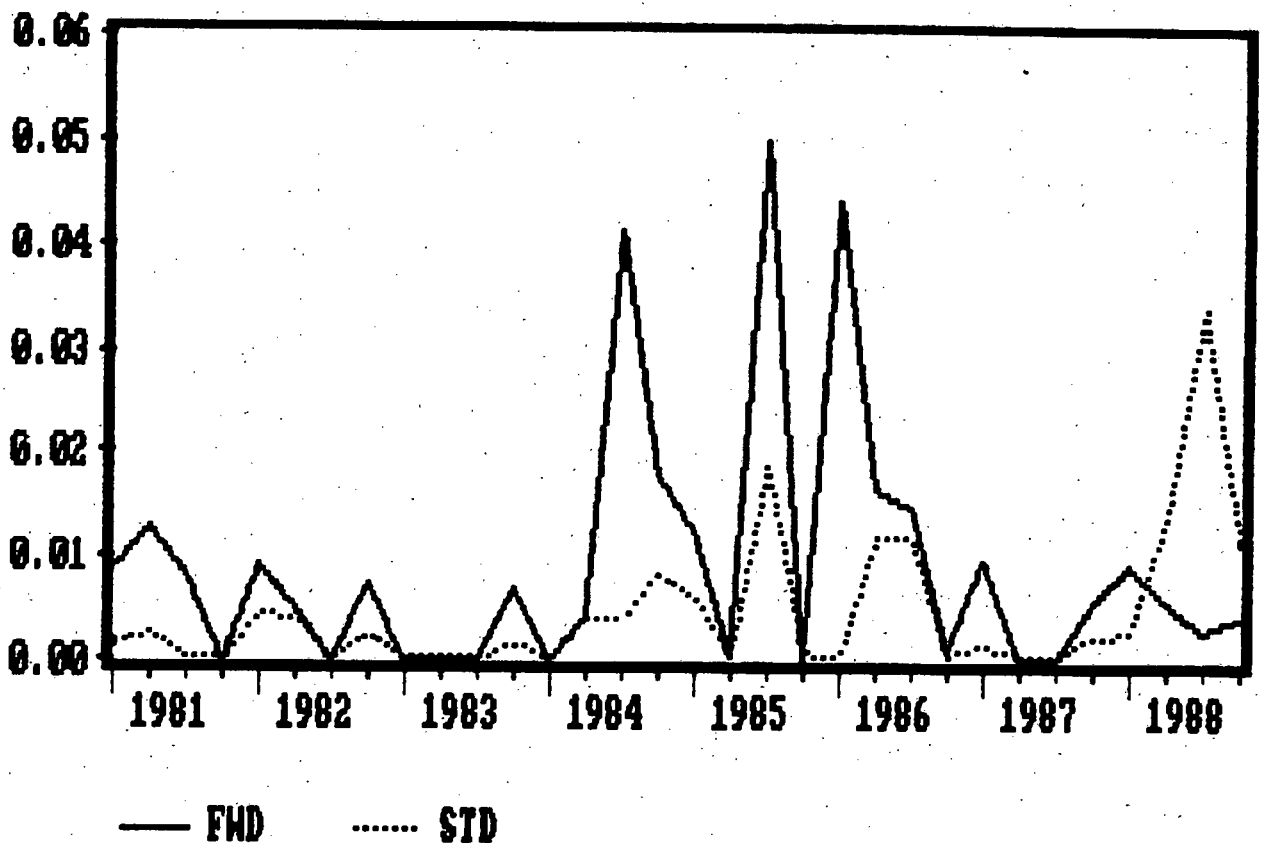
Where S_t is the future spot rate, $S_{f,t-1}$ represents the one-period ahead forecast of the spot rate and E_{t-1} represents the squared forecast error. In Figure 7.1, the squared

² Source: Telephonic interview with Mr Pennington at Standard Bank, Johannesburg.

forecast error of using the Standard Bank's estimate is plotted against the squared forecast error of using the forward exchange rate, which is;

$$E_{F,t-1} = [(S_t - F_{t-1})/S_t]^2 \quad (7.3)$$

FIGURE 7.1 **SQUARED FORECAST ERRORS**
QUARTERLY DATA:
MARCH 1981 - DECEMBER 1988.



In general, over the period 1981 to 1987 the squared forecast errors in using the Standard Bank's estimates were less than the squared forecast errors of using forward exchange rates. This position reversed in 1988, when the mean squared forecast error, using the Standard Bank's estimates, were significantly higher than the mean squared forecast error, using the forward exchange rate. Table 7.7 presents the mean squared forecast errors (M.S.E.) of using the Standard Bank's estimate, the forward exchange rate, and the current spot exchange rate to forecast the future spot exchange rate.

TABLE 7.7 **MEAN SQUARED FORECAST ERROR:**
QUARTERLY DATA
MARCH 1981 - DECEMBER 1988

	<u>M.S.E.</u>	<u>S.D.</u>
Standard Bank Forecast	0.005	0.007
Forward Rate	0.009	0.013
Spot Rate	0.011	0.018

A trader using the standard bank forecast to predict the end-of-quarter spot exchange rate would have reported a

smaller mean forecast error than if the forward rate or spot exchange rate had been employed.

The use of the mean squared forecast error to analyse the forecasting accuracy of the Standard Bank's foreign exchange advisory service may lead to inaccurate conclusions, as the direction of the forecast may be more important than the squared error of the forecast.

The forward rate may result in a forecast which indicates that traders should sell rands while the Standard Bank forecast may reflect the correct realised direction that traders should purchase rands. However, the squared error of the Standard Bank forecast may exceed the squared error of using the forward rate. In this case it is useful to measure the times that the Standard Bank's forecasts are correct in forecasting direction relative to the forward rate.

The direction of change implicit in the Standard Bank forecast ($S_{f,t-1}$) and implicit in the forward rate (F_{t-1}) is compared and evaluated in terms of the realised direction measured by the actual spot rate movement.

The methodology employed to measure direction was implemented as follows;

$$S_t < S_{t-1} = 1 \quad (S_t > S_{t-1} = 0)$$

$$S_{f,t-1} < S_{t-1} = 1 \quad (S_{f,t-1} > S_{t-1} = 0)$$

$$F_{t-1} < S_{t-1} = 1 \quad (F_{t-1} > S_{t-1} = 0)$$

The allotment of 1 to the above captures the general trend in the rand exchange rate over the sample period. The number of times that the forward rate and the Standard Bank forecast correctly predicted the direction of change is compared to the actual direction of change as measured by S_t relative to S_{t-1} .

This involved comparing the actual direction of change in each period to the predicted change indicated by the forward rate and the Standard Bank forecast. The number of times that the forward rate and the Standard Bank forecast correctly predicted the future one quarter direction in the spot rate is presented in Table 7.8.

Over the sample period the actual quarterly direction in the Rand exchange rate was downwards in 22 of the quarters. Of the total directional movements in 31 quarters, the

forward rate correctly predicted the direction of change in 19 quarters. This lends some support to the conclusions reached in Chapter 6 that although the forward rate was a poor predictor of the future spot rate, it may be a better than average indicator of the future directional change in the spot exchange rate. This compares however to the Standard Bank estimates which predicted the correct direction of change in 26 quarters.

TABLE 7.8**TESTS ON DIRECTION OF CHANGE**

QUARTERLY DATA: JUNE 1981 - DECEMBER 1988

No. of Obs : 31

DIRECTIONAL MOVEMENTS

$$S_t < S_{t-1}$$

22

$$S_{f,t-1} < S_{t-1}$$

23

$$F_{t-1} < S_{t-1}$$

28

$$S_t > S_{t-1}$$

9

$$S_{f,t-1} > S_{t-1}$$

8

$$F_{t-1} > S_{t-1}$$

3

NO. OF CORRECT PREDICTIONS

$$S_t$$

31

$$S_{f,t-1}$$

26

$$F_{t-1}$$

19

The test on the relative ability of the forward rate and the Standard Bank forecast to predict the direction of change, indicates that the Standard Bank estimates outperformed the forward rate in predicting the direction of change over the sample period. This supports the prior results of using the mean squared forecast errors to compare the two rates.

It is submitted that the test on directional changes is the more valid test of relative performance. Traders will take positions on the basis of predicted directional changes.

Therefore, if the rand is expected to depreciate against the U.S. dollar, traders will be long in U.S. dollars and short in rands. If the actual directional movement in the rand exchange rate is in accordance with this expectation, then the trader will earn a return from taking that position.

A simple example will further illustrate this point. Assume the current spot exchange rate is \$0.50, the three month forward rate is \$0.45 and the Standard Bank forecast is \$0.51. Based on the forward rate, a trader would sell rands and buy U.S. dollars. However, based on the Standard

Bank forecast, the trader would buy rands and sell U.S. dollars.

If the actual spot exchange rate turns out to be \$0.49, then the trader would have minimised ex post his forecast error by utilising the Standard Bank estimate but would have at the same time recorded a loss from taking a position based on such an estimate.

The directional change predicted by the forward exchange rate would result in the trader taking a profitable position of being long in U.S. dollars and short in rands even though in this case it would result, ex post, in a greater forecast error. The predicted directional change indicates the positions to be taken by traders and thereby determines their profitability.

This indicates that measures of relative performance should be based upon the ability of the forward rate and the Standard Bank estimates to predict directional changes in the future spot exchange rate.

The Standard Bank estimates resulted in smaller mean squared forecast errors and a greater level of accuracy in predicting directional movements in the spot rate relative to the forward rate.

In an efficient market forecasts issued by advisory services should not outperform the forward exchange rate in predicting future directional movements in the spot exchange rate.

The results indicate that Standard Bank may have access to privileged information regarding future directional movements in the spot exchange rate. The results are therefore inconsistent with the efficient market hypothesis.

In Table 7.9, the actual percentage change in the spot exchange rate (SC) is regressed against the percentage change predicted by the Standard Bank advisory service (AC) and the percentage change predicted by the forward premium (FC).

TABLE 7.9**REGRESSION ESTIMATES**

(standard errors in parentheses)

QUARTERLY DATA: JUNE 1981 - DECEMBER 1988

A. Regression Equation: $SC_t = a + bAC_t + u_t$

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>s.e.</u>	<u>R^2</u>	<u>D.W.</u>
-0.022	1.012	0.062	57%	1.55
(0.011)	(0.164)			

B. Regression Equation: $SC_t = a + bFC_t + u_t$

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>s.e.</u>	<u>R^2</u>	<u>D.W.</u>
0.027	0.199	0.094	0.2%	2.06
(0.024)	(0.927)			

The results lend further support to the previous analysis of the performance of the advisory service relative to the quoted forward rate in predicting the future spot exchange rate. The slope coefficient for Equation (A) is not significantly different from unity and the equation reflects a R^2 of 0.57.

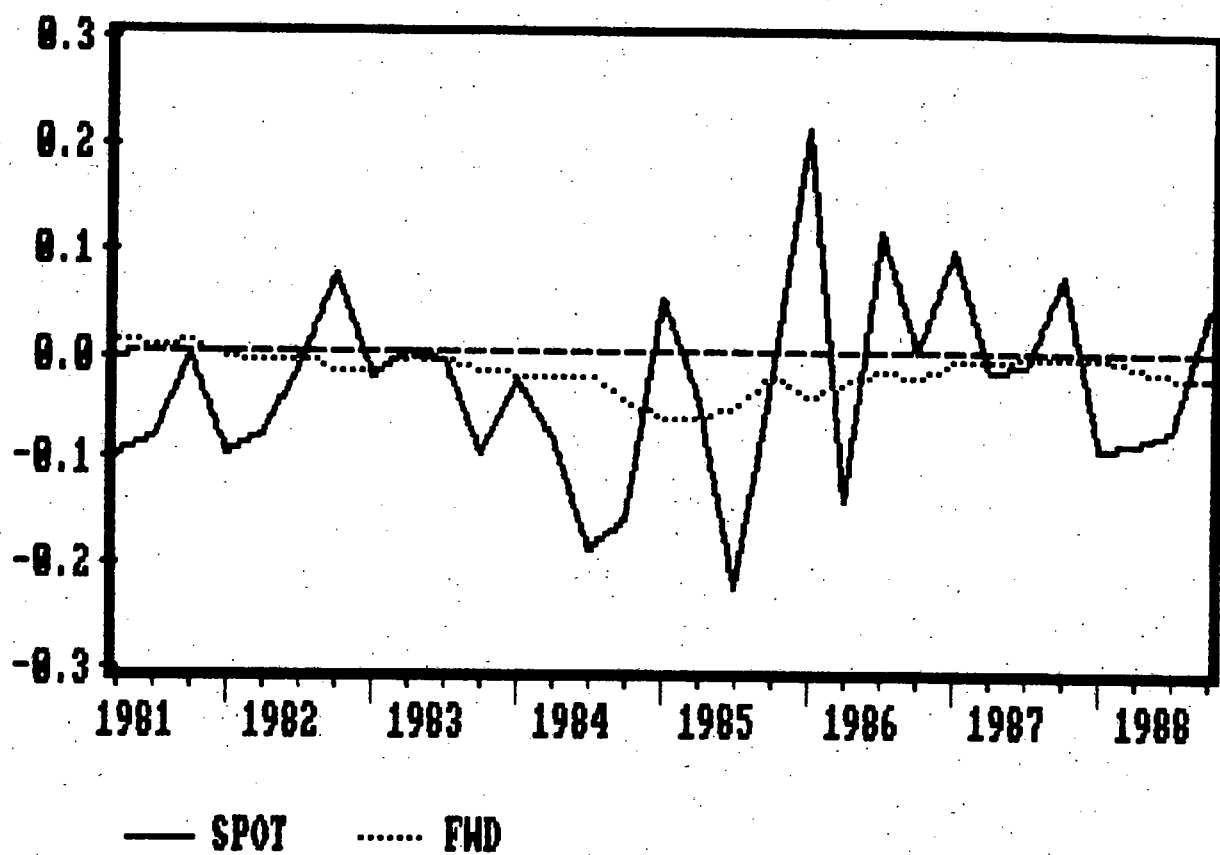
The Durbin-Watson statistic indicates the absence of first order serial correlation given the sample size.

In contrast, the forward premium was not able to predict the change in the spot exchange rate. The slope coefficient for Equation (B) is not significantly different from zero, however it is also not significantly different from unity. The R^2 ratio is very close to zero at 0.002. The Durbin-Watson statistic indicates an absence of first order serial correlation.

In Figure 7.2 the percentage forecasted change in the spot exchange rate as reflected in the Standard Bank forecast is plotted against the actual percentage change experienced over the sample period.

The relationship between the actual change and the predicted change depicted in Figure 7.2 is in contrast to the relationship between the expected change in the spot rate as indicated by the forward premium and the actual percentage change that occurred in the spot exchange rate over the sample period. The latter relationship is depicted in Figure 7.3.

FIGURE 7.3 **ACTUAL AND PREDICTED CHANGES IN THE SPOT
EXCHANGE RATE: THE FORWARD PREMIUM**
JUNE 1981 - DECEMBER 1988



In an efficient market, forecasts issued by advisory services should not outperform the forward exchange rate in predicting the future spot exchange rate.

The results of the mean squared error tests and directional tests, indicate that the forecasts issued by the Standard Bank were able to significantly outperform the forward rate in predicting movements in the spot exchange rate. Regression estimates and analysis of plots lend further support to these findings.

The results are not consistent with the efficient market hypothesis in this context and indicate that traders using the Standard Bank estimates would be able to earn superior returns.

7.4.3. THE FINANCIAL RAND MECHANISM

This section examines the relationship between the movements in the Commercial rand (up to now termed the "spot" rate) and movements in the Financial rand rate. The objective of this section is to test whether a trader would be able to use past movements in the Financial rand rate to predict movements in the spot (Commercial rand) rate.

Barr and Kantor (1983, p.13) state;

"The main purpose of any dual exchange rate system is to isolate the commercial exchange rate from what are regarded as de-stabilising capital flows".

In a dual exchange rate system current account transactions are undertaken through the Commercial rand while designated capital account transactions are undertaken through the Financial rand. In effect Financial rands are South African bank balances owned by non-residents. Non-residents are able to sell such Financial rand balances to other non-residents, for U.S. dollars at a rate negotiated between the two parties. This rate represents the

Financial rand exchange rate and is determined by demand and supply factors.

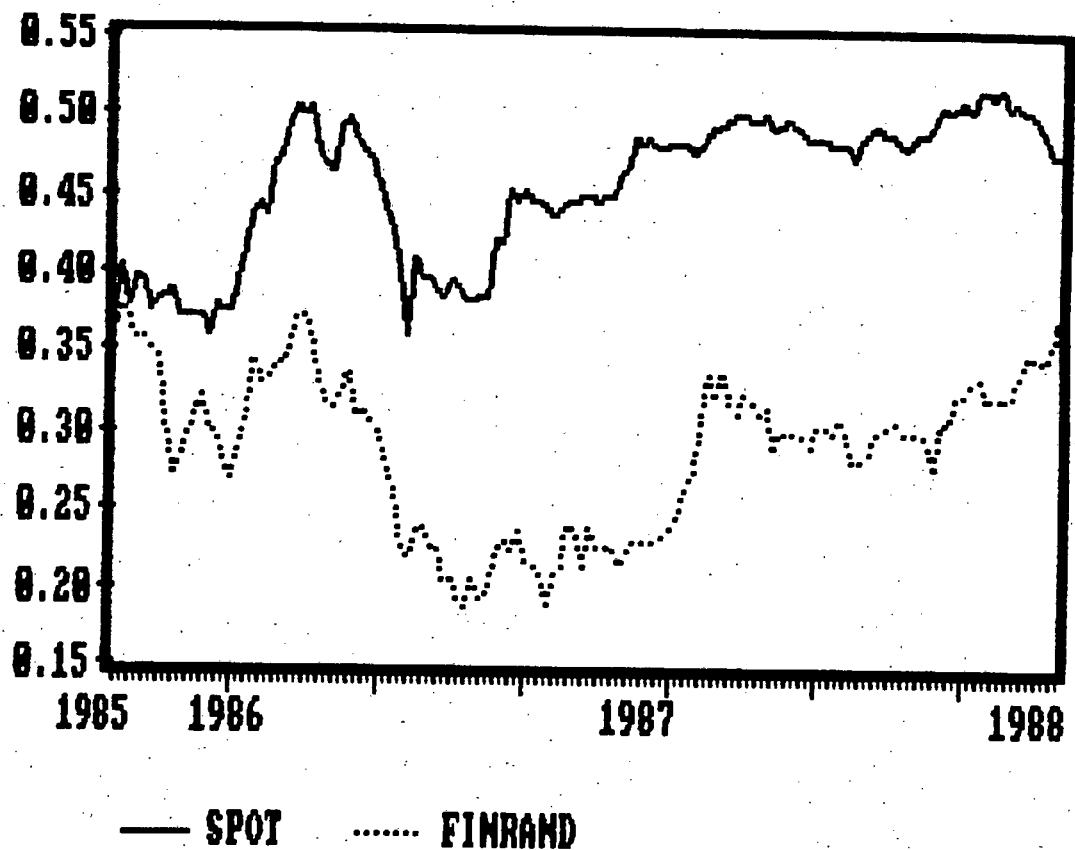
The official foreign exchange reserves are not affected by the supply and demand for Financial rands, and thereby are protected from speculative capital flows. However, in a free floating exchange rate system for the Commercial rand, the foreign exchange reserves should not really be affected anyway by changes in demand and supply of rands in the foreign exchange market. The adjustment should occur through the exchange rate.

The Financial rand is descended from the blocked rand which arose subsequent to the imposition of restrictions on capital repatriation by non-residents, and flowing from the aftermath of the Sharpville disturbances in 1960. In February 1983 the South African authorities adopted a unitary exchange rate system but reintroduced the Financial rand mechanism, with the imposition of the foreign debt standstill, in September 1985.

In Figure 7.4, the weekly spot (Commercial) rand/U.S. dollar exchange rate is plotted against the weekly

Financial rand/U.S. dollar exchange rate for the period September 1985 to February 1988.

FIGURE 7.4 WEEKLY SPOT AND FINANCIAL RAND EXCHANGE RATES
SEPTEMBER 1985 - FEBRUARY 1988



The difference between the two exchange rates (divided by the Commercial rand rate) is known as the Financial rand discount and serves as a barometer of foreign investor confidence in relation to investment in South African securities.

Political risk is obviously an important variable driving the Financial rand exchange rate. For most of 1987 the Financial rand stood at a discount of over 50 percent.

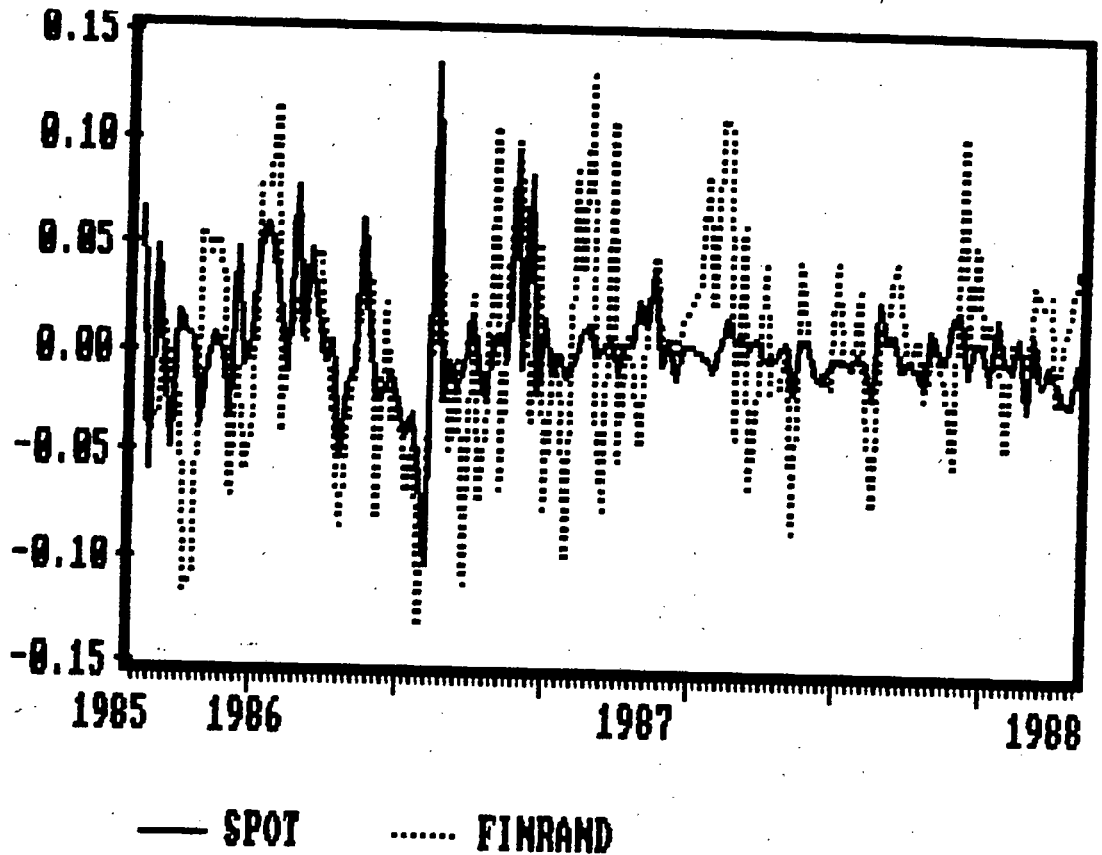
The most important objective of a dual exchange rate system is to remove the destabilising effects of speculative capital flows from the foreign exchange market. Therefore, we would expect movements in the Financial rand exchange rate to be more volatile than movements in the spot exchange rate.

The weekly spot exchange and Financial rand exchange returns are plotted in Figure 7.5 for the period September 1985 to February 1988. Returns are defined and determined as follows (P = price):

$$(P_t - P_{t-1}) / P_{t-1}$$

FIGURE 7.5

WEEKLY SPOT AND FINANCIAL RAND RETURNS
SEPTEMBER 1985 - FEBRUARY 1988.



It is clear that the Financial rand exchange rate has been significantly more volatile than the spot exchange rate over the period. The summary statistics are presented in Table 7.10.

TABLE 7.10

SUMMARY STATISTICS

RAND/U.S. DOLLAR WEEKLY RETURNS

SEPTEMBER 1985 - FEBRUARY 1988.

	<u>Mean</u>	<u>S.D.</u>
Spot exchange rate return	0.0022	0.0288
Financial rate return	0.0014	0.0522

The mean spot exchange rate and Financial rate returns are very close to zero. However, the standard deviation of the Financial rate return is almost twice the standard deviation of the spot exchange rate return.

This implies that non-resident investors were subject to higher degrees of risk, as measured by the level of variability of Financial rate returns.

The question of whether the reintroduction of the Financial rand reduced the volatility in the official foreign exchange market is not directly answerable.

TABLE 7.11

SUMMARY STATISTICS

RAND/U.S. DOLLAR WEEKLY RETURNS

AUGUST 1983 - AUGUST 1985.

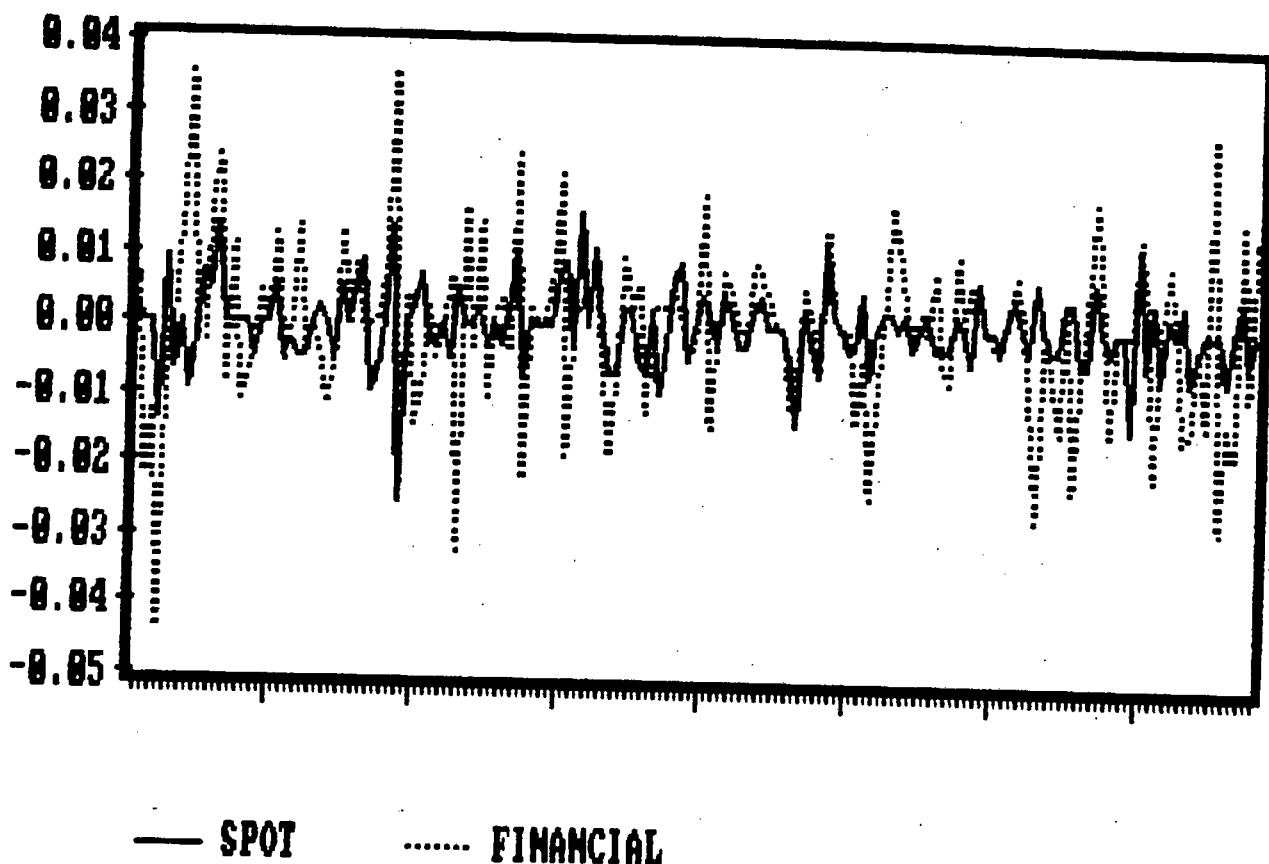
	<u>Mean</u>	<u>S.D.</u>
Spot exchange rate	-0.00787	0.03485

In Figure 7.6, the daily rand/sterling Commercial exchange rate return is plotted against the daily rand/sterling Financial rate return for the period 21 November 1988 to 26 June 1989. The mean return for both the spot and Financial sterling daily returns is extremely close to zero (less than 0.0006).

However, the standard deviation of the spot rate returns was 0.006 compared to the standard deviation of 0.012 for the Financial sterling returns. Therefore, the volatility in the Financial sterling daily returns significantly exceeded the level of volatility in the spot sterling exchange rate.

FIGURE 7.6

DAILY SPOT AND FINANCIAL STERLING RATE RETURNS
21 NOVEMBER 1988 - 26 JUNE 1989.



If exchange rates respond immediately to new information which alters expectations, then there should be a high correlation between changes in the spot exchange rate and changes in the Financial rand exchange rate. Table 7.12 presents the estimates of regressing the weekly spot rand/U.S. dollar exchange rate return (SR) against the

contemporaneous weekly Financial rand/U.S. dollar exchange rate return (FR) for the period September 1985 to February 1988.

TABLE 7.12 **RESULTS OF REGRESSION EQUATION :**

$$SR_t = a + bFR_t + u_t$$

(standard errors in parentheses)

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
0.0019	0.2171	15.5%	0.0265	2.42
(0.0023)	(0.0449)			

The slope coefficient is statistically significant at the 95 percent confidence level. However, the slope coefficient is also significantly different from unity. Although there is a statistically significant relationship between spot exchange returns and Financial rate returns, the R^2 of 15.5 percent is less than expected, in relation to the two exchange rates reacting to new information. This was hinted at by the tests on relative variability.

The above regression equation was tested for daily spot and Financial rate returns for the rand/sterling exchange rate for the period 21 November to 26 June 1989. The slope

coefficient of 0.16 was significant and the R^2 was 12 percent. The Durbin-Watson statistic of 2.33 indicated an absence of first order autocorrelation.

These results may be due to inefficiencies in the Financial rand market as it represents a thin market in relation to the spot foreign exchange market. There is some evidence that the Financial rand rate returns exhibit limited serial correlation.

The two markets may represent two different classes of traders. Non-residents may react differently compared to residents to the same set of new information. Therefore, new information may impact on the expectations of non-residents and residents, but in different ways. This implies that the spot exchange rate and Financial rate markets may be efficient (to the extent they represent separate markets) even though the two classes of investors react differently to the same set of new information.

It may be the view that non-residents over-react to news. Alternatively residents may under-react to "news". This may be due to information asymmetry - however traders may

efficiently set prices on the basis of the limited available information.

This may be seen as justification for government intervention through the creation of the Financial rand mechanism to "segregate" non-residents, and thereby reduce the effects that these "over-reactions" can have on the spot exchange rate. The existence of a significant Financial rand discount when there are obvious economic motives for arbitrage between the two markets, is evidence that in general the Commercial and Financial rate markets constitute separate markets.

Information asymmetry may be due to non-residents having access to information sources not available to residents (or vice-versa).

The question pertinent for this thesis, however, refers to whether traders were able to utilise publicly available information on the Financial rand rates to improve their forecasts of the future Commercial rand exchange rate?

Barr and Kantor (1983, p.19) state;

"the financial rand discount anticipates movements in the commercial rand exchange rate".

If the spot foreign exchange market is efficient then traders should not be able to use lagged Financial rate returns to forecast future spot exchange rate returns. Table 7.13 presents the estimates of regressing spot exchange returns against the one lag Financial rate returns. The slope coefficient is not statistically significant and the R^2 of the equation is low at 2.3 per cent. The Durbin-Watson statistic of 2.2 indicates an absence of first order serial correlation.

TABLE 7.13

RESULTS OF REGRESSION EQUATION :

$$SR_t = a + bFR_{t-1} + u_t$$

WEEKLY RETURNS: SEPTEMBER 1985 - FEBRUARY 1988.

(standard errors in parentheses)

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
0.0016	0.082	2.3%	0.028	2.20
(0.0025)	(0.0477)			

Regression equations using further lagged Financial rate returns were estimated but none of these equations resulted in significant estimates. In terms of the daily rand/sterling data, the use of lagged Financial sterling returns did not result in significant estimates. The slope coefficient is significantly different from unity at the 5 percent level of significance.

If the spot exchange rate market is efficient, then traders should not be able to use lagged Financial rate returns to improve their forecasts of the future spot exchange rate. The results of the tests are consistent with this hypothesis and therefore support the efficient market hypothesis.

However, the less than expected co-variability of spot exchange returns and financial exchange rate returns, may reflect information asymmetry and the fact that new information impacts upon non-resident and resident expectations in different ways albeit the markets may be efficient. As mean returns for both markets are close to zero, the latter point may have some support.

In the next section, we examine the relationship between the spot exchange rate and variables such as current

account balances, the gold price, the level of the country's foreign exchange reserves and money supply growth.

Barr and Kantor (1983, p.18) state;

"The predominant forces that determine the managed commercial rand exchange rate seem to be ... the state of the balance of payments and the level of foreign exchange reserves. The most important and readily available information about the prospects for the South African balance of payments is, of course, given by the gold price. As would be expected, there is a strong empirical relationship between the dollar gold price and commercial rand exchange rate".

The objective of this section is to examine whether a statistically significant relationship exists between the spot exchange rate and each of these variables, and most importantly to test whether traders would be able to use publicly available information on specific variables to improve their forecast of the future spot exchange rate.

The section first studies the relationship between the spot exchange rate and the dollar gold price.

7.4.4 SPOT EXCHANGE RATES AND THE GOLD PRICE

Movements in the dollar gold price have material effects on the country's balance of payments and domestic economy. A significant proportion of state tax revenues arise from taxes levied on gold mining profits. Therefore, the authorities may be inclined to undertake a policy of maintaining a given rand gold price in order to protect government revenues.

The monthly percentage change in the spot exchange rate (SR) is regressed against the monthly percentage change in the London dollar gold price (GP) for the period July 1979 to June 1989. The regression estimates are presented in Table 7.14.

The constant and slope coefficients are significantly different from zero, indicating that there is a positive relationship between changes in the dollar gold price and changes in the spot rand/U.S. dollar exchange rate.

However, the R^2 is unexpectedly low, in relation to the importance of the gold price to South Africa's balance of payments and domestic economy. The Durbin-Watson statistic of 1.96 indicates an absence of first order autocorrelation.

TABLE 7.14 **RESULTS OF REGRESSION EQUATION :**

$$SR_t = a + bGPG_t + u_t$$

(standard errors in parentheses)

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
-0.009	0.174	7.0%	0.047	1.96
(0.004)	(0.058)			

These results compare with the results reached in Barr and Kantor's (1983) study which indicated a stronger relationship between movements in the spot exchange rate and movements in the contemporaneous gold price. However, Barr and Kantor tested the period prior to the adoption of a managed floating exchange rate system.

In terms of market efficiency, the objective is to test whether traders were able to use publicly available

7.4.5 SPOT EXCHANGE RATES AND CHANGES IN FOREIGN EXCHANGE RESERVES

The state of the Reserve Bank's foreign exchange reserves may be an important indicator of future directional movements in the spot exchange rate. The level of the foreign exchange reserves may indicate whether the Reserve Bank is able to intervene to support a given spot exchange rate. Low levels of foreign exchange reserves may result in adverse leads and lags which place further pressures on the spot exchange rate.

During the rand/U.S. dollar-peg era, the authorities generally substantiated a downward adjustment to the exchange rate by quoting the reason that this would improve the balance of payments and the country's foreign exchange reserves (see Chapter 2).

In a free floating exchange rate system, the adjustment should occur through the exchange rate rather than through changes in the foreign exchange reserves.

The monthly percentage change in the spot exchange rate (SR) is regressed against the monthly percentage change (R)

in the gold and foreign exchange reserves (stated in U.S. dollars) for the 10 year period September 1979 to June 1989. The results are presented in Table 7.15.

TABLE 7.15 **RESULTS OF REGRESSION EQUATION :**

$$SR_t = a + bR_t + u_t$$

(standard errors in parentheses)

SEPTEMBER 1979 - JUNE 1989

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
-0.009	0.185	16%	0.045	2.08
(0.004)	(0.039)			

The results of the estimated regression equation indicate that there is a significant relationship between changes in the Reserve Bank's gold and foreign exchange reserves and changes in the spot Rand exchange rate. The slope coefficient is significantly different from unity. The R^2 is 16 percent and the Durbin-Watson statistic indicates an absence of first order autocorrelation.

The above regression equation was further estimated for lagged changes in the Reserve Bank's gold and foreign exchange reserves; however, the coefficients of the

equations tested were not significant and the values of R^2 were close to zero. Therefore traders were unable to use past changes in the Reserve Bank's gold and foreign exchange reserves to improve forecasts of the future spot exchange rate.

There exists a significant relationship between changes in the spot exchange rate and contemporaneous changes in the Reserve Bank's gold and foreign exchange reserves. The question arises of whether traders were able to use this relationship to improve their forecasts of the future spot exchange rate.

Due to the time delay between changes in the foreign exchange reserves and the publication of these changes in reserves, it is highly unlikely that traders would be able to obtain such information contemporaneously, and thereby improve their forecasts of the future spot exchange rate.

7.4.6 SPOT EXCHANGE RATES AND MONEY SUPPLY

The monetary approach to exchange rate determination emphasises the role of national monies in determining the exchange rate. Caves and Feige (1980, p.120) state;

"While it is recognised that the exchange rate is not purely a monetary phenomenon (being affected in part by the real determinants of the demand for money), the thrust of the new asset approach to exchange rates is that the exchange rate is primarily determined by current and past innovations in the relative supplies of national monies."

Caves and Feige (1980, p.121) go on to state;

"If the foreign exchange market is incrementally efficient with respect to monetary disturbances, then the spot exchange rates already incorporate the systematic information contained in the past history of money supply disturbances, thus vitiating some of the directly testable

implications of the monetary approach to exchange rate determination."

The objective of this thesis is to test for market efficiency. If the foreign exchange market is efficient, then traders should not be able to utilise past money supply data to improve their forecasts of the future spot exchange rate.

If the spot exchange rate reflects all available information, then there should not be a systematic relationship between past information of national monies and the exchange rate.

In Table 7.16, changes in the money supply are regressed against changes in the spot exchange rate for monthly and quarterly data.

TABLE 7.16

REGRESSION ESTIMATES :

THE RAND/U.S. DOLLAR RATE AND MONEY SUPPLY (M_t)
(standard errors in parentheses)

A. Regression Equation: $S_t = a + bM_t + u_t$

Monthly Data

Period: July 1979 - April 1989

No. of observations: 118

Money Supply definition: M1 + demand deposits with banking institutions

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
-0.007	-0.064	0.2%	0.048	1.88
(0.005)	(0.126)			

B. Regression Equation: $S_t = a + bM_t + u_t$

Quarterly Data

Period: 1981.1 - 1989.1

No. of observations: 33

Money Supply definition: M1

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
-0.020	-0.329	3.0%	0.09	1.98
(0.020)	(0.322)			

The regression estimates are not significant and the low values of R^2 for both regression equations indicate that money supply changes have little explanatory power over changes in the spot exchange rate. The slope coefficients for both equations are significantly different from zero. The Durbin-Watson statistics for both equations indicate the absence of first order serial correlation.

It is interesting to note that Gerson and Kahn (1988) found that monetary developments were not a significant determinant of real exchange rate movements.

The regression equations were further tested by using lagged values of money supply changes, however, in both cases the coefficients were found to be insignificant and the value of R^2 was in each case very close to zero. Further, in each case the Durbin-Watson statistic was close to two, indicating the absence of first order serial correlation.

In Figures 7.7 and 7.8, changes in the money supply are plotted against changes in the exchange rate for the monthly and quarterly data.

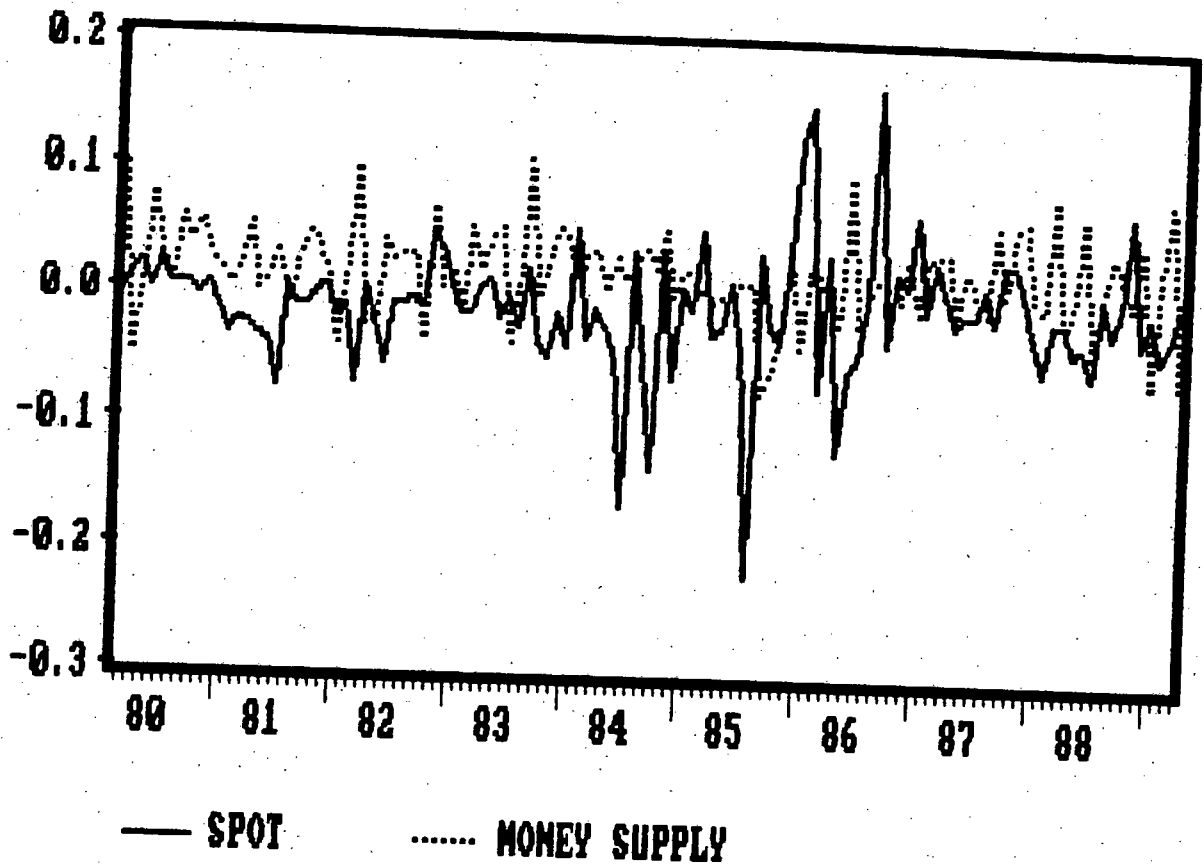
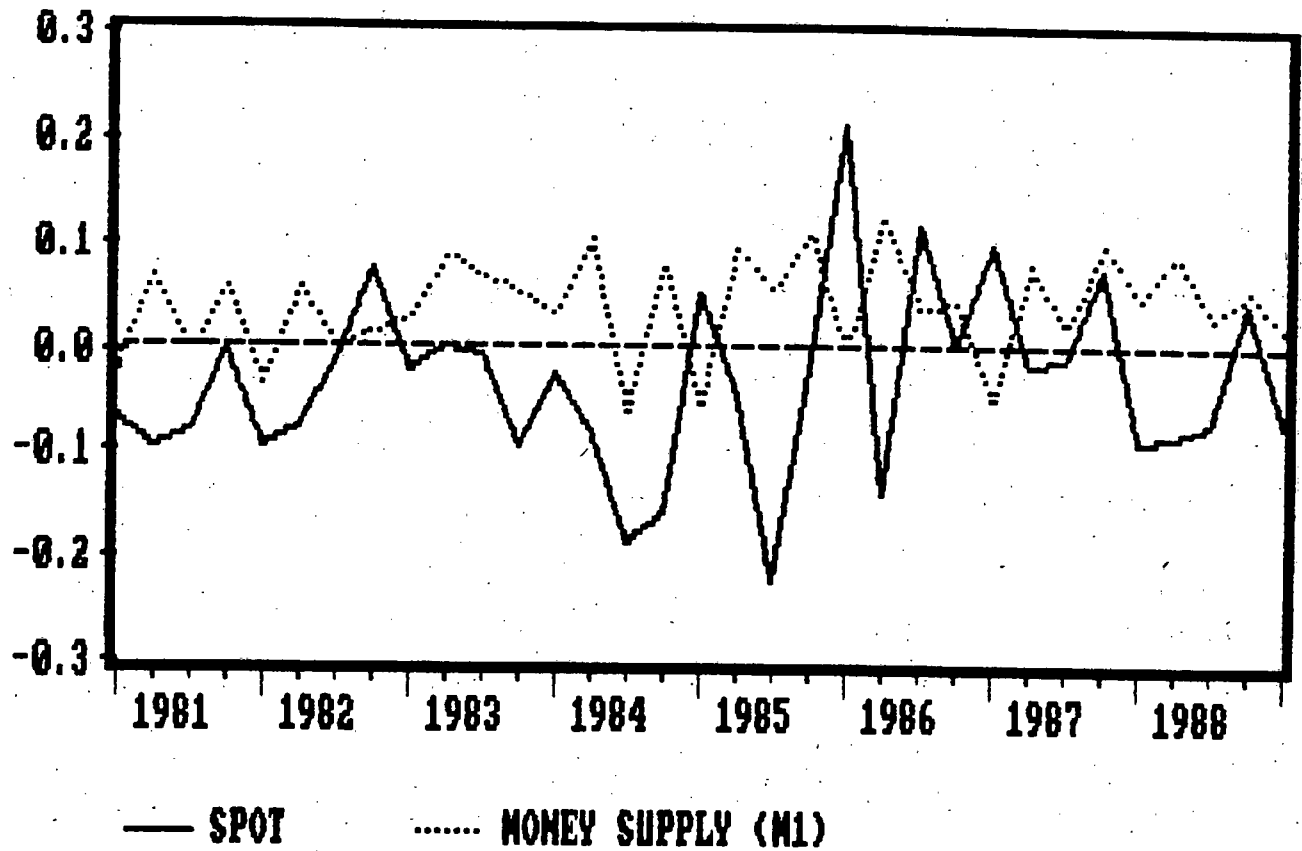
FIGURE 7.7**CHANGES IN THE SPOT RATE AND MONEY SUPPLY****MONTHLY DATA: MARCH 1980 - APRIL 1989**

FIGURE 7.8**CHANGES IN THE SPOT RATE AND MONEY SUPPLY****QUARTERLY DATA: JUNE 1981 - MARCH 1989**

There is no apparent relationship between percentage changes in the spot rate and percentage changes in the money supply. However, in both cases the volatility of changes in the exchange rate exceeds the volatility of changes in the money supply.

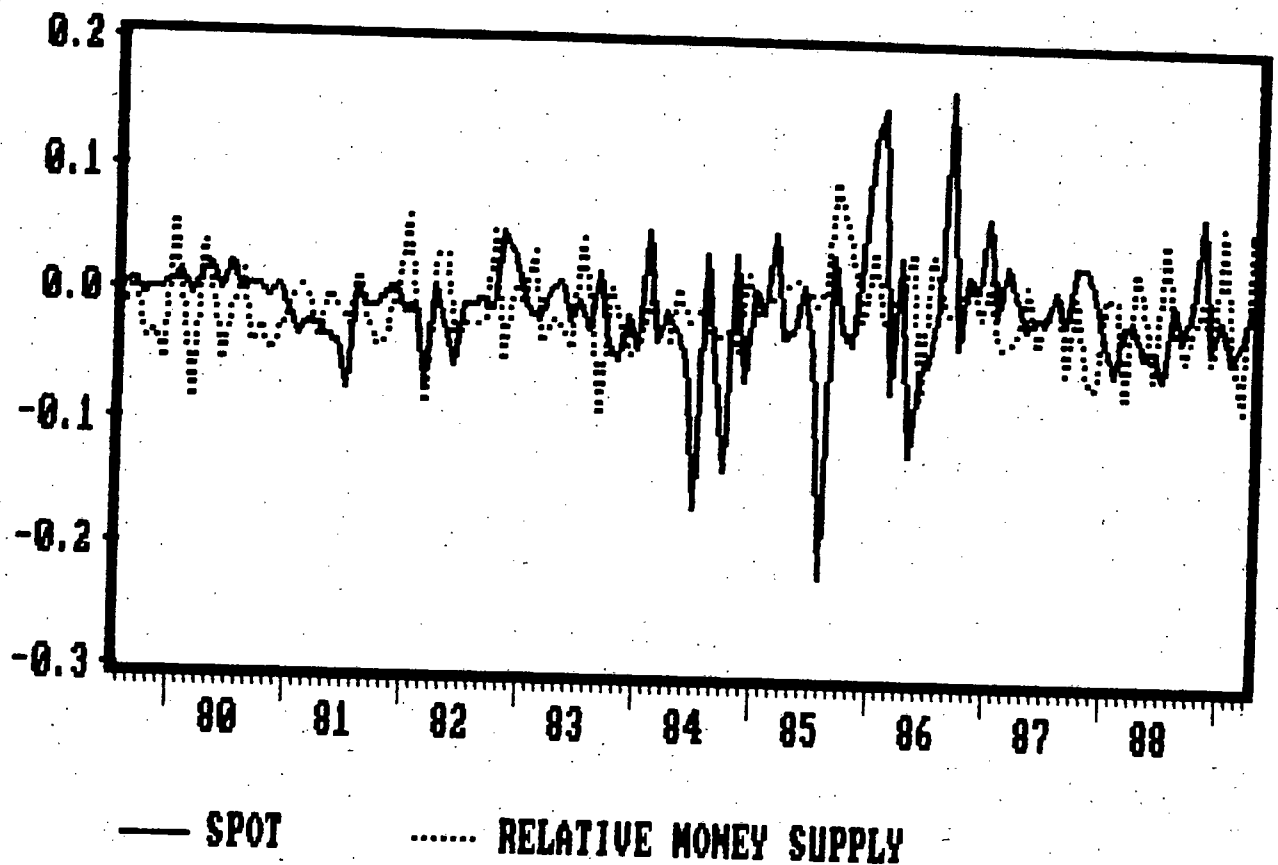
The monetary approach to exchange rate determination states that the exchange rate is determined by the relative money supplies in two countries. The data tested in this section relate to South Africa's money supply figures recorded within each sample period. In terms of the tests of market efficiency the money supply figures form part of the public information set, therefore in an efficient market, traders should not be able to use past information on money supply data to improve their forecasts of the future spot exchange rate.

The results indicate little correlation between changes in the spot exchange rate and contemporaneous changes in the money supply. Further tests using lagged values of changes in the money supply result in estimates not significantly different from zero, and values of R^2 close to zero. These results are consistent with market efficiency in that traders were not able to use past information of changes in the money supply to earn excess returns.

However, the monetary approach to exchange rate determination emphasises the role of relative supplies of national monies. In an efficient market, traders would not be able to use past information of relative money supplies

to improve their forecasts of the future spot exchange rate. In Figure 7.9, the monthly percentage change in the spot exchange rate is plotted against the monthly percentage change in relative money supplies (MS_{US}/MS_{SA})

FIGURE 7.9 **THE EXCHANGE RATE AND RELATIVE MONEY SUPPLIES**
MONTHLY DATA : AUGUST 1979 - APRIL 1989



The volatility of changes in the spot rate exceeds the volatility of changes in the relative money supply ratio. The mean percentage change in the spot exchange rate is -0.008 with a standard deviation of 0.048 while the mean percentage change in the money supply ratio is -0.010 with a standard deviation of 0.035. Table 7.17 presents the results of the following regression equation;

$$SR_t = a + bMR_t + u_t$$

where SR_t is the monthly percentage change in the spot rate and MR_t is the monthly percentage change in the relative money supply ratio (MS_{US}/MS_{SA}) for the period August 1979 to April 1989.

TABLE 7-17

RESULTS OF REGRESSION EQUATION:

$$SR_t = a + bMR_t + u_t$$

(standard errors in parentheses)

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
0.008	0.055	0.2%	0.049	1.88
(0.005)	(0.127)			

The results reflect insignificant estimates while the low R^2 indicates that relative money supply changes have little explanatory power in relation to changes in the spot exchange rate. The slope coefficient is significantly different from unity. The Durbin-Watson statistic indicates an absence of first order serial correlation.

The regression equation was further tested by using lagged values of relative money supplies, but in each case the estimates were insignificant and the values of R^2 were very close to zero. These results are consistent with the efficient market hypothesis.

Traders were not able to utilise past information of changes in relative money supplies to improve forecasts of the future spot exchange rate. There is no systematic relationship between exchange rate changes and changes in relative money supplies.

7.4.7. EXCHANGE RATES AND THE BALANCE OF PAYMENTS

The "flow" model of exchange rate determination states that the exchange rate is determined by the demand by residents for foreign exchange and the supply of foreign exchange by non-residents.

The demand for foreign exchange is determined primarily by the demand by residents for foreign goods while the supply of foreign exchange depends on non-resident demand for local goods. Therefore, the exchange rate is primarily determined by the imports and exports of goods and the exchange rate will adjust to equilibrate the current account.

In the Bretton-Woods era, exchange rate changes were only permitted once a country experienced "fundamental disequilibrium" which was primarily defined as a country incurring persistent current account imbalances.

The possibility of highly elastic capital flows was then hardly ever considered. The experience with floating exchange rate systems saw the increasing acceptance of the asset market approach of exchange rate determination.

In this section, the objective is to test whether traders would be able to use past information on current account balances to improve forecasts of the future spot exchange rate. If the foreign exchange market is efficient, then there should not be a systematic relationship between changes in the spot exchange rate and past changes in the current account balance.

In the period 1981 to 1988, South Africa experienced a significant shift from a current account deficit to a current account surplus. In Figure 7.10 the current account balance is plotted over the period March 1981 to March 1989 in US dollar and rand terms.

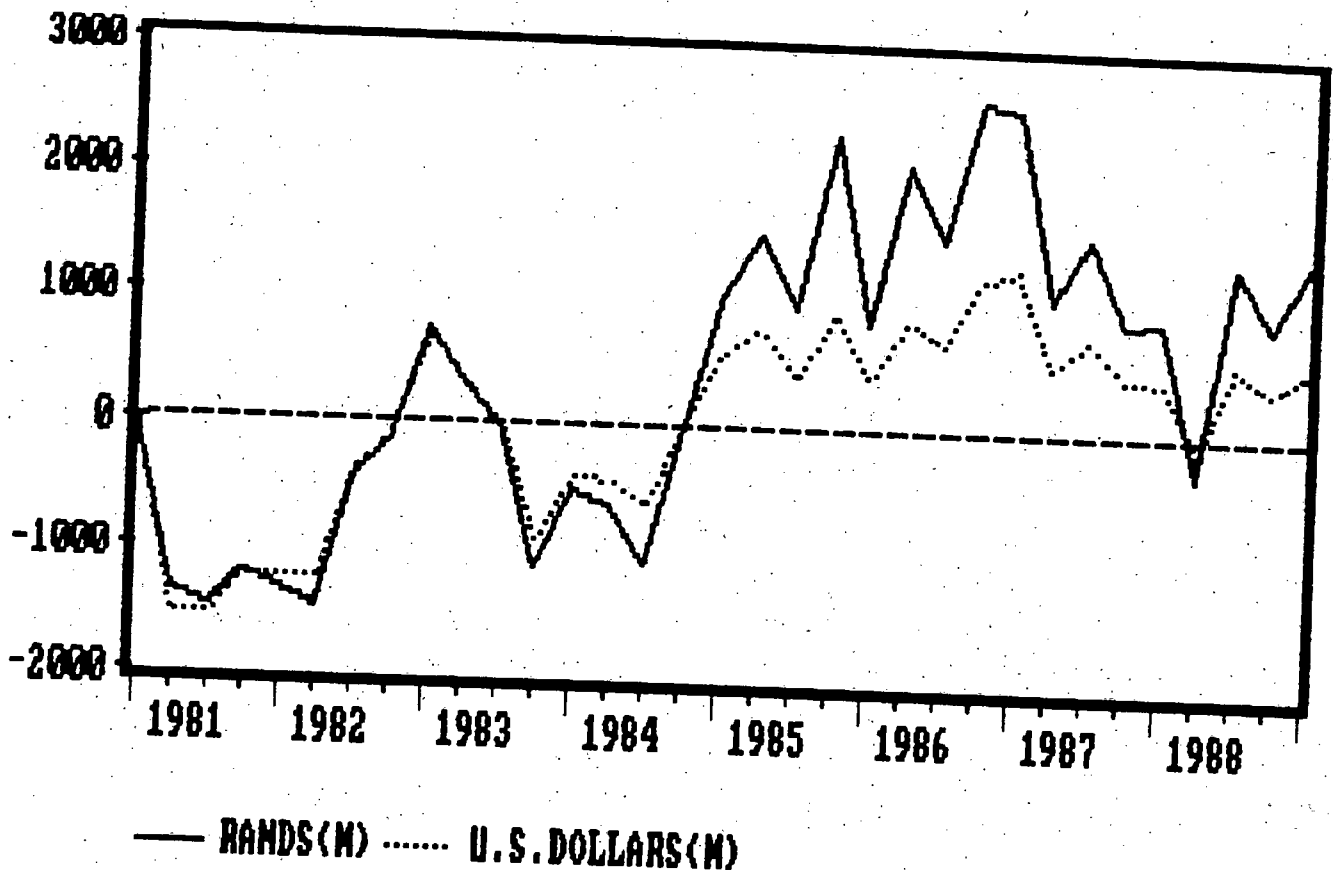
In 1984 the current account moved from a deficit into surplus. The significant increase in the current account surplus in rand terms compared to U.S. dollar terms, is due to the material decline in the rand/U.S. dollar exchange rate in 1984, which with the decline in domestic economic activity resulted in the positive balance on the current account.

FIGURE 7.10

THE BALANCE ON THE CURRENT ACCOUNT

QUARTERLY DATA: MARCH 1981 - MARCH 1989

RAND/U.S. DOLLARS (MILLIONS)



Changes in the rand exchange rate (S_t) were regressed against changes in the current account (BOP_t) for the

period March 1981 to March 1989 on a quarterly data basis. The results are presented in Table 7.18.

TABLE 7.18 **RESULTS OF REGRESSION EQUATION :**

$$S_t = a + bBOP_t + u_t$$

(standard errors in parentheses)

<u>\hat{a}</u>	<u>\hat{b}</u>	<u>R^2</u>	<u>s.e.</u>	<u>D.W.</u>
-0.031	-0.0006	1.9%	0.09	2.06
(0.016)	(0.0008)			

The regression estimates are not significantly different from zero. The slope coefficient is significantly different from unity. The low R^2 of 1.9 percent indicates that movements in current account balances have little explanatory power over movements in the exchange rate. The Durbin-Watson statistic of 2.06 indicates an absence of first order serial correlation.

The above regression equation was further tested by using lagged values of changes in the current account balance, but in each case the estimates were found to be insignificant and the values of R^2 were found to be very close to zero.

In an efficient market a systematic relationship should not exist between changes in the spot exchange rate and past changes in the current account balance. The results of the tests are consistent with the efficient market hypothesis. Traders were not able to use past information of changes in the current account balance to improve forecasts of the future spot exchange rate.

7.5 CONCLUSION

In this chapter, tests were applied to measure the efficiency of the spot exchange market. An efficient market has been defined as one in which prices fully reflect available information (Fama, 1970). This implies that traders cannot use available information to systematically improve their forecasts of future prices. This is due to the fact that in an efficient foreign exchange market, exchange rates react immediately to new information, thereby rendering such information valueless for forecasting purposes.

Market efficiency is a wide economic statement and therefore requires the specification of testable hypotheses. Market efficiency is therefore measured in terms of specified information sets.

The first tests were based on testing for weak-form efficiency. The specified information set under weak-form efficiency tests, is the past history of the spot exchange rate. If the market is efficient, then traders should not be able to systematically forecast the future spot exchange rate on the basis of past movements in the spot exchange rate.

The spot exchange rate was regressed against the lagged spot exchange rate and was found to follow a random walk. If the equilibrium return is constant then this is consistent with an efficient market. Further, the mean deviation of the spot rate minus the subsequently observed spot rate, was not significantly different from zero.

Tests for serial correlation were expanded by examining the autocorrelation function for the rand/U.S. dollar exchange rate for monthly returns, the rand/U.S. dollar, rand/sterling and rand/deutschemark exchange rates for

daily returns and the rand/sterling, rand/lira and rand/U.S. dollar exchange rates for weekly returns over specified time periods.

In general, the tests reflected autocorrelation coefficients which were not statistically different from zero. This indicates that spot exchange rate movements are random and there are therefore no linear trends in spot exchange rate changes. However, there were a few autocorrelation coefficients which were statistically significant and the tests for dependencies were expanded by applying filter trading rules.

If the foreign exchange market is efficient, then filter trading rules should not outperform a simple buy-and-hold policy. Filter trading rules were applied for a number of currencies over various time periods. The results of the tests on the filter trading rules are consistent with an efficient foreign exchange market as the filter trading rules selected were not able to outperform a buy-and-hold policy.

However, certain filter trading rules did result in higher returns than a simple buy-and-hold policy once an

adjustment was made for interest returns earned on securities quoted in each currency.

However, once a further adjustment was made to include a minimum level of transaction costs to undertake the transactions required under a filter trading rule, these excess returns disappeared. Therefore, filter trading rules failed to outperform a simple buy-and-hold policy once an adjustment is made for interest returns and transaction costs. These results are therefore consistent with market efficiency, in that traders would not be able to use past movements in the exchange rate to improve their forecasts of the future spot exchange rate.

A foreign exchange market is semi-strong efficient if exchange rates reflect all publicly available information.

This chapter included tests on the forecasting accuracy of the Standard Bank's foreign exchange advisory service. The forecasts have been included as part of the public information set as the forecasts are widely disseminated. If the foreign exchange market is efficient then the foreign exchange advisory service forecasts should not be

able to systematically outperform the forward rate as a predictor of the future spot exchange rate.

The measurement of forecasting accuracy was undertaken through the comparison of mean squared forecasting errors and the application of directional tests. The results indicate that traders who used the advisory service forecasts would have reported significantly smaller mean squared forecasting errors. In addition advisory service forecasts outperformed the forward rate in predicting the directional change in the spot exchange rate.

These results are not consistent with the efficient market hypothesis. In an efficient market, advisory service forecasts should not systematically outperform the forward rate as a predictor of the future spot exchange rate. This may reflect access to privileged information as the Standard Bank is one of the major dealers in the foreign exchange spot market.

Market efficiency was further tested by analysing the relationship between the spot exchange rate and selected "fundamental" variables. These variables included the Financial rand exchange rate, the dollar gold price,

changes in the gold and foreign exchange reserves, money supply growth and the balance on the current account.

The first test analysed the relationship between the spot exchange rate (the Commercial rand) and the Financial rand exchange rate. As the Financial rand rate is determined by demand and supply factors and reflects non-resident perceptions, there exists an argument that the financial rand may anticipate future movements in the spot exchange rate.

The results indicate that the Financial rand exchange rate recorded a significantly greater degree of volatility than the spot exchange rate and the adoption of the Financial rand mechanism in 1985 may have reduced the volatility in the spot or Commercial rand exchange rate. Further, the regression estimates reflect a limited but statistically significant correlation between changes in the spot rate and contemporaneous changes in the Financial rand exchange rate.

However, regressing the spot exchange rate against lagged values of the Financial rand did not result in estimates significantly different from zero and the values of R^2 were

very close to zero. These results are consistent with market efficiency as traders were not able to utilise past information on Financial rate returns to improve forecasts of the future spot exchange rate.

Although there exists a statistically significant relationship between changes in the spot exchange rate and contemporaneous changes in the dollar gold price, traders would not be able to use this relationship, as it reflects a contemporaneous relationship, to improve their forecasts of the future spot exchange rate.

The regression equation was further tested by using lagged changes in the dollar gold price. The estimates were not significantly different from zero while the values of R^2 were very close to zero. This is consistent with market efficiency as traders would not be able to utilise past information on the gold price to improve forecasts of the future spot exchange rate.

A significant relationship exists between changes in the spot exchange rate and contemporaneous changes in the Reserve Bank's gold and foreign exchange reserves. However, there is no significant relationship between

changes in the spot rate and past changes in the gold and foreign exchange reserves. Again, this result is consistent with market efficiency.

If the foreign exchange market is efficient, then traders should not be able to utilise past information on money supply to improve forecasts of the future spot exchange rate. The results of regression equations used to test the relationship between changes in money supply and changes in the spot exchange rate reflect coefficients which are not significant and values of R^2 which are very close to zero. There does not exist a statistically significant relationship between changes in the spot exchange rate and contemporaneous changes in the money supply.

The monetary approach to exchange rate determination emphasises the role of relative money supplies in determining the exchange rate. Changes in the spot exchange rate was further regressed against changes in relative money supplies. The coefficients of the regression equation were not significant while the values of R^2 were very close to zero. Further tests on lagged values of relative money supplies resulted in insignificant

coefficients and values of R^2 which were very close to zero.

The results are consistent with the efficient market hypothesis in that traders were not be able to use past information of money supplies to improve their forecasts of the future spot exchange rate.

Over the period 1981 to 1988, South Africa experienced a fundamental change in its balance of payments position. In the period 1981 to 1984, South Africa reflected a current account deficit while in the period subsequent to 1984, South Africa's balance on the current account has generally been positive. Over this period the rand showed a marked decline in value against the major currencies, and the capital account reflected significant outflows (see Chapter 3).

The current account balance does not merely reflect the decline in the rand exchange rate; there has been a significant turnaround even when the balance on current account is stated in U.S. dollars.

The regression equation testing the relationship between changes in the spot exchange rate and changes in the contemporaneous and lagged changes in the balance on current account (stated in U.S. dollars) reflected coefficients which were insignificant and values of R^2 which were very close to zero.

These results are consistent with market efficiency in that traders were not able to use past changes in the current account balance to improve their forecasts of the future spot exchange rate.

In this chapter, market efficiency was measured in terms of specified information sets. The first information set consisted of the past history of exchange rates. The results of the serial correlation and filter trading rule tests are generally consistent with weak-form market efficiency.

The semi-strong tests of market efficiency consisted of testing the relationship between the spot exchange rate and such "fundamental" variables as the Financial rand exchange rate, the dollar gold price, the Reserve Bank's gold and foreign exchange reserves, relative money supplies and the

balance on the current account. The results of the tests are consistent with market efficiency in that traders would not be able to utilise past information of these variables to improve forecasts of the future spot exchange rate.

However, in an efficient foreign exchange market, forecasts issued by advisory services should not systematically outperform the forward rate as a predictor of the future spot exchange rate. The results of the tests on the forecasting performance of an advisory service are inconsistent with the efficient market hypothesis. The advisory service forecasts consistently outperformed the forward rate as a predictor of the future spot exchange rate.

Market efficiency has been measured in terms of specified information sets. The weak-form and semi-strong form tests are generally consistent with market efficiency. However, the superior forecasting performance of the Standard Bank's foreign exchange advisory service forecasts over the sample period relative to the forward rate is not consistent with market efficiency.

As the advisory service tested is one of the major participants in the South African foreign exchange market, the tests may represent a test of strong-form efficiency and the results may indicate an absence of market efficiency in the strong-form sense.

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CHAPTER 8

CONCLUSIONS

8.1 CONCLUSIONS

This thesis has examined and documented tests on the efficiency of the South African foreign exchange market. The thesis was divided into two parts. Part 1 examined recent developments in the South African foreign exchange market and Part 2 consisted of an examination and review of empirical studies on market efficiency, and tests of the weak form and semi-strong form levels of efficiency in the South African foreign exchange market.

Chapter 1 defined and described sufficient and necessary conditions for market efficiency.

Chapters 2 and 3 form Part 1 of the study. Chapter 2 examined developments in the South African foreign exchange market from 1971 to the date of the Commission of Inquiry's Interim report in 1979. During this period the Reserve

Bank generally followed a policy of maintaining a rand/U.S. dollar peg and undertaking major adjustments to the peg based on South Africa's balance of payments position and the level of the Reserve Bank's foreign exchange reserves.

The Reserve Bank applied wide ranging controls over the foreign exchange market by not only setting the exchange rate but, for example, also setting the bid-ask spread at the retail level. The pricing of forward exchange did not reflect covered interest parity.

A system of extensive Exchange Controls over residents and non-residents was in place. South Africa applied a dual exchange rate system. Therefore, at that stage the South African foreign exchange market did not reflect conditions consistent with an efficient and competitive market.

The current exchange rate did not reflect expectations, and there was no immediate adjustment to the exchange rate if new information arose which impacted on expectations regarding the future spot exchange rate. However, pressures on the Reserve Bank's foreign exchange reserves may have led the authorities to alter the rand/U.S. dollar peg.

The significant deviations from covered interest parity implied that there existed opportunities to undertake risk-free covered interest arbitrage transactions. However, the system of Exchange Controls may have restricted the ability of market participants to undertake arbitrage and speculative activities which would result in the exchange rate reflecting expectations.

The Commission of Inquiry recommended the establishment of a flexible exchange rate system and the pricing of forward exchange which reflected covered interest parity. These recommendations were adopted. In 1983 restrictions on non-residents were removed, thereby resulting in the effective abolition of South Africa's dual exchange rate system. There began a process of market liberalisation but this process was reversed and the dual exchange rate system reinstated with the declaration of the debt standstill in 1985.

At the present time, although South Africa has a flexible exchange rate system, there remains a system of extensive Exchange Controls in place which impact on the economic freedom of investors and traders to transact in foreign

- technical trading rules should not consistently outperform a simple buy-and-hold policy.
- professional forecasting services should not consistently outperform the forward rate in predicting the future spot exchange rate.
- investors should not be able to earn abnormal returns from forecasts of the exchange rate based on publicly available information.

This thesis involved testing the weak and semi-strong forms of market efficiency. This means that tests of market efficiency are relevant to the extent that exchange rates fully reflect the publicly available information set.

Chapter 4 represents an examination and review of empirical research studies on covered interest parity and weak and semi-strong forms of market efficiency. The majority of these studies were conducted on U.S. data and a few studies on U.K. data.

Chapter 5 consisted of tests of the first hypothesis. In an efficient market covered interest risk-free profit opportunities should be quickly eliminated. Transaction costs result in boundaries around the covered interest parity line. Covered interest parity deviations will not imply that the foreign exchange market is inefficient unless these apparent risk-free profit opportunities exceed related transaction costs.

Chapter 5 presents the theory of covered interest parity and graphically depicts the covered interest parity relationship. The effect of deviations from interest parity on equilibrating capital flows is explained.

Covered interest parity was studied for the period August 1983 to February 1988 using South African and New York three month Bankers Acceptance rates. Covered interest parity was also tested using South African and United States monthly prime overdraft rates and the one-month forward dollar premium over the period January 1983 to October 1986.

The quoted forward dollar premium is plotted against the expected interest parity value of the forward premium and

descriptive statistics are presented relating to mean deviations and standard deviations. Regression equations are estimated for the quoted dollar premium and covered interest parity relationship. Transaction costs are estimated and deviations from covered interest parity are evaluated in relation to the level of transaction costs.

Chapter 5 concludes, based on empirical tests over the period August 1983 to February 1988, that although deviations from covered interest parity did occur over this period, these apparent risk-free covered interest profit opportunities did not exceed, except for a limited period, related transaction costs. These conclusions are valid for the securities tested.

Deviations from covered interest parity increased over the period August 1985 to February 1988, reflecting the period subsequent to the debt standstill and the extension of direct controls. The deviations from covered interest parity over this period reflected consistently a quoted forward dollar premium which was less than its interest parity value. This would be expected to encourage capital inflows. However, these deviations did not exceed related transaction costs.

Therefore, the results of Chapter 5 are generally consistent with market efficiency. In an efficient foreign exchange market, covered interest arbitrage opportunities are quickly eliminated. The study was unable to reject Hypothesis 1.

The conclusions reached in Chapter 5 are in contrast with other overseas studies (see, for example, Aliber, 1973 and Dooley and Isard, 1980). This thesis used securities issued in different political jurisdictions to predict the forward rate.

Studies of developed economies have generally reported deviations from covered interest parity when using securities issued in different political jurisdictions, whereas deviations from covered interest parity are not sufficient to offset transaction costs when comparing securities issued in Euro-currency markets.

It has been reported that deviations from covered interest parity are due to differences in political risk, capital controls and taxation (see, for example, Aliber, 1973 and Dooley and Isard, 1980). To the extent that these factors

are relevant in South Africa, we would expect to report significant deviations from covered interest parity.

However, the difference in the overall tax rate between South Africa and the U.S.A. does not appear to be material. Further, the system of exchange and capital controls may be ineffectual, and the large capital outflows reported in Chapter 3, provide support for this argument.

In an efficient market covered interest arbitrage opportunities should be quickly eliminated and the empirical findings are consistent with the first hypothesis. However, as a suggestion for further research, covered interest parity should be empirically tested using Euro-currency interest securities.

The second hypothesis and related conditions were tested in Chapters 6 and 7.

Chapter 6 tested for market efficiency by examining the relationship between the spot rate and the forward rate. In an efficient market, assuming a zero risk premium, the forward rate should be a weak but unbiased predictor of the future spot rate.

The following OLS regression equation was tested;

$$S_t = a + bF_{t-1} + u_t$$

This was tested for monthly and quarterly data. The results are generally consistent with the Efficient Market Hypothesis, in that the constant is not significantly different from zero and the slope coefficient is not significantly different from unity. The error term is not serially correlated.

Lagged values of the forward rate were added to the equation. As F_{t-1} includes all information; including information implicit in the lagged forward rate, F_{t-2} , the addition of the lagged forward rate should not result in an improvement in the goodness of fit nor in coefficients which are significantly different from zero. Again, the empirical results are consistent with market efficiency.

The forward premium (reflecting the expected change in the spot rate) was plotted against realised changes in the spot rate, and was found to be a weak predictor of the future change in the spot rate.

If the current spot rate and forward rate embody all current information, then new information which alters expectations regarding the future spot rate, should be immediately reflected in the spot and forward rates. Therefore, a high correlation between movements in the spot rate and movements in the contemporaneous forward rate is consistent with market efficiency. The empirical tests in Chapter 6 indicated a high correlation between movements in the spot rate and movements in the contemporaneous forward exchange rate.

Descriptive statistics reflecting the forecast errors of using the forward rate and the current spot rate to predict the future spot rate were produced. The mean deviations were found to be not significantly different from zero. The lagged spot rate was as good a predictor of the future spot rate as the forward rate.

In an efficient market, the forward rate should be an unbiased predictor of the future spot rate if investors and traders are risk neutral. If the pricing of forward exchange includes a risk premium, then the existence of bias in the forward exchange rate is consistent with market efficiency. The existence of a risk premium is tested in

Chapter 6 by examining the mean forecast error of using the forward rate as a predictor of the future spot rate and testing for serial correlation.

In the South African foreign exchange market, the mean forward forecast error was found to be not significantly different from zero. This result is consistent with a zero risk premium but is also consistent with a risk premium that often changes sign but has a mean of zero. Therefore, to test for a time varying risk premium in the pricing of forward exchange, the autocorrelations of the forward forecast errors were calculated, and were generally found to be not significant. This is therefore not consistent with the existence of a time varying risk premium.

As the results of these tests were consistent with a zero risk premium, this tended to validate earlier assumptions.

Although the empirical results in Chapter 6 are generally consistent with market efficiency, it was found that the current spot rate may be as good a predictor of the future spot rate as the corresponding forward rate. This is consistent with the results of other studies and valid

arguments have been propagated why this should be so (see, for example, Chrystal and Thornton, 1988).

The market for interest securities may reflect inefficiencies, so that although the forward rate may reflect covered interest parity, it may not reflect the market's expectations of the future spot rate.

Arbitrage through equilibrating capital flows would ensure that the forward rate reflects the market's expectations of the future spot rate. To the extent that inefficiencies in the form of exchange controls restrict these arbitrage transactions, this may indicate that the forward rate may not reflect the expected future spot rate but the absence of bias in the pricing of forward exchange may not be consistent with this argument.

Chapter 6 tested the second hypothesis by specifically testing the following conditions;

- there should be a strong correlation between movements in the spot rate and movements in the contemporaneous forward rate, and

- the forward rate should be an unbiased predictor of the future spot rate.

The results of the tests were generally consistent with market efficiency.

Chapter 7 consisted of examining the second hypothesis by specifically testing for weak and semi-strong forms of market efficiency. Market efficiency is measured in terms of specified information sets. The specified information set under weak form efficiency tests is the past history of the spot exchange rate.

Tests for weak form efficiency involved the application of various methodologies. Firstly, the spot rate was regressed against the lagged spot rate and found to follow a random walk. Further, the mean deviation of the spot rate minus the subsequently observed spot rate was not significantly different from zero.

Tests for serial correlation were undertaken by examining the autocorrelation function for the rand/U.S. dollar rate for monthly returns, the rand/U.S. dollar, rand/sterling and rand/deutschemark rates for daily returns and the

rand/sterling, rand/lira and rand/U.S. dollar rate for weekly returns.

Generally, the tests reflected autocorrelation coefficients which were not significantly different from zero. These results are consistent with market efficiency, as exchange rate movements are random and there are no linear trends in exchange rate changes.

A further test of weak form efficiency involved testing the profitability of technical trading rules. If the foreign exchange market is efficient, then filter trading rules should not consistently outperform a simple buy-and-hold policy.

Filter trading rules were applied for a number of currencies over various time periods and for a number of filters. The results of the tests on filter trading rules are consistent with an efficient foreign exchange market. Filter trading rules were not able to outperform a simple buy-and-hold policy once an adjustment was made for interest returns earned on securities quoted in each currency, and once an adjustment was made for a minimum level of transaction costs.

This is in contrast to the results of such studies as Cornell and Dietrich (1978) who found that although autocorrelation tests indicated that exchange rate changes reflected "white noise", the use of filter trading rules reflected significantly greater returns than following a simple buy-and-hold policy. However, the methodology used in this thesis is more rigorous as an adjustment was made for interest returns earned for the specific periods that traders were in each currency. As depreciating currencies usually reflect higher interest rates, this was considered important to this thesis. This is consistent with why Cornell and Dietrich may have reported significant returns from using filter trading rules.

A foreign exchange market is semi-strong efficient if exchange rates reflect all publicly available information.

Chapter 7 included tests on the forecasting accuracy of the Standard Bank foreign exchange advisory service. If the foreign exchange market is efficient then the Standard Bank's forecasts should not be able to systematically outperform the forward rate as a predictor of the future spot exchange rate.

The measurement of forecasting accuracy was undertaken through the comparison of mean squared forecasting errors and the use of directional tests. The results are not consistent with market efficiency. For the period tested, traders who used the advisory service's forecasts would have reported significantly smaller mean squared forecasting errors. In addition, the advisory service outperformed the forward rate in predicting the directional change in the spot exchange rate.

Although these results are not consistent with market efficiency, this may reflect monopolistic access to information as the Standard Bank is one of the major dealers in the foreign exchange market. Therefore, this test may reflect a test of the strong form level of efficiency, and the results may indicate an absence of market efficiency in the strong form sense.

In Chapter 7, market efficiency is further tested by analysing the relationship between changes in the spot rate and changes in selected macro-economic variables, including the Financial rand rate, the dollar gold price, changes in

foreign exchange reserves, money supply and relative money supplies and the balance on the current account.

Tests indicated a statistically significant correlation between movements in the spot rate and movements in the current Financial rand rate, the current gold price and the Reserve Bank's foreign exchange reserves. Although these represented statistically significant relationships, as these were contemporaneous changes, it is doubtful that traders would be able to use such relationships to improve their forecasts of the future spot exchange rate.

The regressions were applied to lagged changes in the above variables and the estimates were not significantly different from zero, and the values of R^2 were very close to zero. Traders would not be able to use past information on these variables to improve forecasts of the future spot exchange rate.

Information on current and lagged money supply growth, relative money supplies and the balance on the current account were found to be not significant in explaining exchange rate movements. This is consistent with market efficiency as traders were not able to use publicly

available information on these variables to improve forecasts of the future spot rate.

Therefore, chapter 7 consisted of tests of the second hypothesis, and involved specific tests for weak form and semi-strong forms of efficiency. The following conditions, as specified in Chapter 1 under Hypothesis 2, were tested;

- technical trading rules should not consistently outperform a simple buy-and-hold policy.
- professional forecasting services should not consistently outperform the forward rate in predicting the future spot rate.
- investors should not be able to earn abnormal returns from forecasts of the exchange rate based on publicly available information.

In general, the results of the tests are consistent with the weak form and semi-strong forms of market efficiency and the thesis was unable to reject Hypothesis 2.

This is surprising as the system of exchange controls in the South African foreign exchange market do not reflect conditions conducive to the free functioning of a market. However, the results of testing specific hypotheses indicate that exchange rate movements are in line with what would be expected to occur in an efficient market.

The existence of exchange controls and evidence of market efficiency may indicate that exchange controls have been ineffectual, and that there are a sufficient number of traders/speculators to ensure that the exchange rate reflects the market's expectations of the future spot exchange rate.

A caveat to this conclusion is necessary. Firstly, there is no general test of overall market efficiency, and this thesis does not purport to test for overall efficiency. Therefore, the empirical evidence in this thesis which is consistent with market efficiency is limited to the results of testing specific hypotheses.

Secondly, the results are limited to the sample periods tested and the limiting assumption (specified in chapter 1) of a constant equilibrium return.

Although the results of the tests in this thesis are generally consistent with the weak and semi-strong forms of market efficiency, the thesis however found that the Standard Bank advisory forecasting service was able to consistently outperform the forward rate in predicting the future spot rate.

This is not consistent with market efficiency, but as this may reflect monopolistic access to information, this may indicate an absence of efficiency in the strong form sense.

8.2 SUGGESTIONS FOR FURTHER RESEARCH

It is appropriate to end this thesis by offering suggestions for possible future research. Firstly, this thesis concluded that the pricing of forward exchange reflected covered interest parity. This is based on the comparison of South African and U.S. interest securities. It would be useful to expand this avenue of research by using South African and Euro-currency interest securities to test for covered interest parity. Further research could take the form of testing for deviations from covered interest parity based on the after-tax yields of selected interest securities. This would require a period-by-period comparison of tax legislation in both countries.

Another possible avenue for further research is to measure exchange rate expectations by using survey data and thereby provide another perspective for testing the existence of a risk premium in the pricing of forward exchange. A further research area relates to the measurement of the forecasting accuracy of relative interest rate based forecasts of the future spot exchange rate. Further, it would be useful to test the accuracy of composite forecasts.

South Africa follows a dual exchange rate system. The Financial rand market is noted to be a very thin market. A useful avenue for further research would be to employ serial correlation tests and filter trading rules to measure the efficiency of the Financial rand market.

Further research is required to measure the effectiveness of exchange controls and the impact that exchange control regulations have on the South African economy. The role of "news" has become a key factor in explaining exchange rate movements. In an efficient market the predominant cause of exchange rate fluctuations is news which by definition could not have been anticipated. An avenue for further research may be to equate news to "unanticipated" changes in explanatory variables, such as money supply, and to test the relationship between movements in the exchange rate and unanticipated changes in the explanatory variables.

This obviously necessitates the determination of "expected" changes in these variables. The results of such research may indicate that the relationship between movements in the exchange rates and changes in an explanatory variable may be based on whether changes in a variable such as money supply growth were in line with expectations.

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